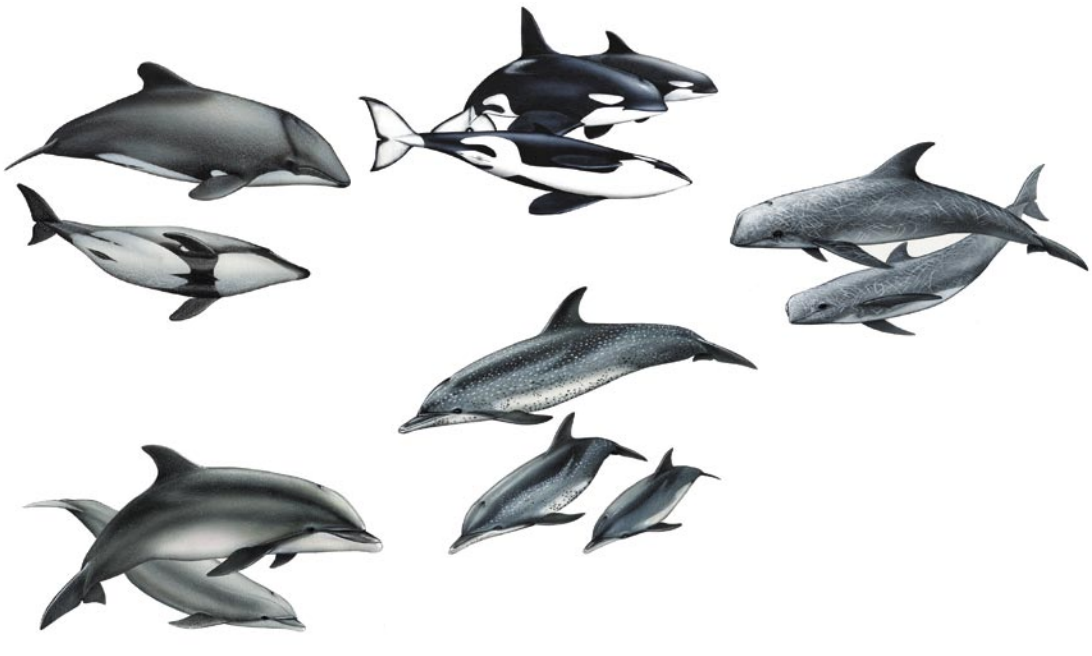
Review of Small Cetaceans

Distribution, Behaviour, Migration and Threats

by Boris M. Culik
Illustrations by Maurizio Wurtz, Artescienza

Marine Mammal Action Plan/
Regional Seas Reports and Studies no. 177



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UNEP/CMS

Foreword
Dr. Klaus Töpfer

Unfortunately, all cetacean species face a number of threats. Some of these are from natural causes such as predators but the majority of threats facing cetaceans today result from either direct or indirect human impacts, including bycatch in fisheries, habitat degradation, marine pollution, acoustic disturbance and competition with fisheries. As highly mobile species with individual ranges covering vast areas of ocean, these marine mammals present special challenges for their conservation.

Public outcry over the plight of marine mammals has motivated the international community to protect them at national, regional and international levels. Greater priority was also given to the protection of the unique creatures by the United Nations in the early 1980s. Seeing an opportunity to organize collective efforts into one global conservation effort, the UN brought governments together which resulted in a Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals. This Action Plan serves to generate consensus among governments on basic policy related to marine mammal protection and management. It integrates research on such issues as the creation of sanctuaries, prohibition of access to breeding areas and setting of catch limits.

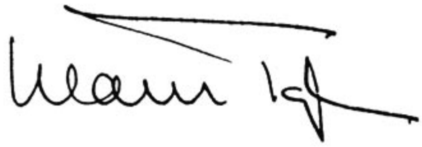
At the regional level the Marine Mammal Action Plan has helped to enhance the technical and institutional capacities for the conservation and management of marine mammals in several Regional Seas programmes, particularly those of Latin America and the Caribbean, Eastern Africa, West and Central Africa, the Black Sea and South-East Asia.

Several international partners of this Action Plan, notably the IWC, CMS and CITES and NGOs such as Greenpeace, IFAW and WWF play an important role in the conservation of small and medium sized cetaceans. Only recently, the Irrawaddy dolphin, was transferred from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II to Appendix I, which forbids all commercial trade. This is an example of binding management actions in regard to small and medium-sized cetaceans taken by a global convention.

Small cetaceans are also covered by two regional agreements of the Convention on Migratory Species (CMS): the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS). Similar CMS initiatives are being developed for the South Pacific, South-East Asia and West Africa as well. In addition, CMS supports important activities such as field surveys and training, technical workshops and conferences, as well as scientific publications like this one.

This publication is one result of the collaboration between UNEP and CMS on the plight of marine mammals. Compiled by marine biologist Prof. Dr. Boris Culik, for the Bonn Secretariat of CMS, it summarizes the available knowledge on toothed whales distribution, behavior, migration and threats.

We hope this comprehensive review will encourage greater public awareness of the importance of marine conservation and the benefits for marine biodiversity, and will improve our understanding of threats to these threatened species. It offers an opportunity to reinforce our commitment to marine mammal conservation and management, and to revitalize our 20-year partnership to implement the Marine Mammal Action Plan.



Dr. Klaus Töpfer, Executive Director of UNEP

Foreword
Robert Hepworth

Small cetaceans are at the centre of marine mammals conservation within the Convention on Migratory Species. The important role of CMS' Regional Agreements, ACCOBAMS and ASCOBANS, is being reflected in their enhanced collaboration with the United Nations Environment Programme (UNEP). They contribute to implementing the Joint Work Programme between CMS and the Convention on Biological Diversity (CBD). As such they play a vital role within the preparation and implementation of national biodiversity strategies and action plans.

This reference book is intended for experts in the field of marine biology, students, and conservationists as well as for interested laypersons. No comparable encyclopedia on whales has been published so far. With the exception of the sperm whale, all 72 species of toothed whales that migrate across the oceans are covered. What is new about this review is that it is based on the most recent literature available and compiled by a single author and not by a variety of experts. It highlights the threats whales are exposed to. A description and a picture are dedicated to each species. A detailed list of references to every single species adds particular value to the study. The most up to date maps available illustrate their distribution. Population size, biology, migration patterns and threats are dealt with in further chapters. These new findings on distribution, behaviour and migration will facilitate the application of targeted action plans and threat mitigating methods.

The study was published for the first time on the CMS website in 2001. Readers were invited to submit comments to the author. Since then the publication has been continuously amended and supplemented up to and including 2004. The fact that experts were given the opportunity to review the study before printing is quite unique and ensures its high scientific value. With the results of the most recent research undertaken this publication makes a valuable contribution to seeking efficient conservation strategies for cetaceans.

I would like to thank the Division of Environmental Conventions of UNEP for publishing this important review. It heralds the revitalisation of the Marine Mammals Action Plan where I hope that CMS will work with related Conventions, UNEP's Regional Seas Programmes, NGOs and others towards the conservation of marine mammals.

R G Hepworth

Robert Hepworth, Executive Secretary of CMS

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1 Preface

This report summarises the available knowledge on odontocete (toothed whale) distribution, behaviour, migration and threats and was compiled for the Bonn Secretariat of CMS.

First of all, how is the term "migration" to be interpreted? According to the Bonn Convention on the Conservation of Migratory Species of Wild Animals, "Migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries".

What methods were employed to compile this review? While I compiled published information, I sent several emails via the marine mammal science (MARMAM) and the European Cetacean Society (ECS) list servers in order to obtain the latest information from the specialists in the field. The information returned, for which I am very grateful, is cited as (pers. comm.) in the report where appropriate. With respect to scientific papers, I used the Aquatic Science and Fisheries Abstract (ASFA Silver Platter) from 1978–2003 as well as the Biological Abstracts Service from 1990–2003 available at the library of the Institut für Meereskunde, Kiel. Both services monitor a very wide variety of biological, aquatic and marine scientific literature and are very good sources of full abstracts of scientific papers. To select relevant publications, I used the coarsest possible filter, i.e. the species name, and then selected "by hand" as well as via the Reference Manager software the appropriate sources from the wide variety of information presented. Where possible, I obtained the original papers in order to incorporate firsthand information in this report. Moreover, this review summarises information spread over a variety of media, i.e. books, scientific papers, conference abstracts and the internet. All sources are quoted individually for each species or genus.

This paper is intended to summarise available information on migratory patterns of odontocetes on a species and population level. However, in many cases we still know too little to subdivide odontocete species into reproductively isolated populations. Rice (1998) stated that: "Initial faith in the near-infallibility of molecular studies has now been tempered by a more sober appraisal of their strengths and weaknesses. Molecular techniques are not free of many of the difficulties that beset morphological techniques, and they have some of their own... Perhaps the most serious deficiency that has compromised the credibility of many molecular phylogenetic studies is that each higher taxon is usually represented by only one or a few of its species. Another serious deficiency has been the routine use of only one or at most few specimens to represent each species, so that no cognisance is taken of individual or geographic variation. For example, in a cladogram based on the amino acid sequences of myoglobin, one specimen of *Delphinus delphis* formed a clade with *Tursiops truncatus* and *Stenella frontalis*, but another specimen formed a clade with *Globicephala melas* and *Orcinus orca*." (Rice 1998)

With respect to migratory behaviour, another word of caution came from Robin Baird (pers. comm.): "I know that for most species of cetaceans the information available on possible migratory patterns is pretty sparse, and what is available is often fraught with sampling biases. I'm amazed how often people conclude animals migrate because they don't see them during the winter (when the days are short, the amount of survey effort is minimal etc.)." Finally, I would -point out that the range states mentioned under the heading "Remarks" are not necessarily countries where the species has been directly sighted (these are found under "Distribution") but those states touched by the distribution of the species as shown on the maps. With these limitations in mind, I hope that the reader will find this "snapshot"-review of available information useful, be it as a basis for future conservation efforts, or to outline the necessity for further research.

I would like to thank W.F. Perrin, La Jolla, California, for proof-reading the first version of the MS, for his constructive and helpful criticism, and for sharing with me the most recent IWC literature. Special thanks go also to R. Strempel of ASCOBANS, Bonn, Germany, for proof-reading this final version and his many helpful comments.

Kiel, December 2004 Boris Culik

2 Summary and Recommendations

A summary on the current knowledge, IUCN, CITES and CMS status, the extent of migratory behaviour, the populations or sub-populations currently included in CMS appendices and the type of migratory behaviour can be found in table 1. This table follows the taxonomical organisation of the review. Recommendations for additions to or amendments of CMS appendices are given in bold. These recommendations are again summarised below. Finally, a summary of the threats endangering small cetaceans in the wild can be found on table 2 (see page 8).

A. Species by species summary

Of the 71 small cetacean species considered in this review, only 33 are included in App. II of CMS. Three species are endemic to a particular nation – the vaquita (*Phocoena sinus*; Mexico), Hector's dolphin (*Cephalorhynchus hectori*; New Zealand) and the baiji

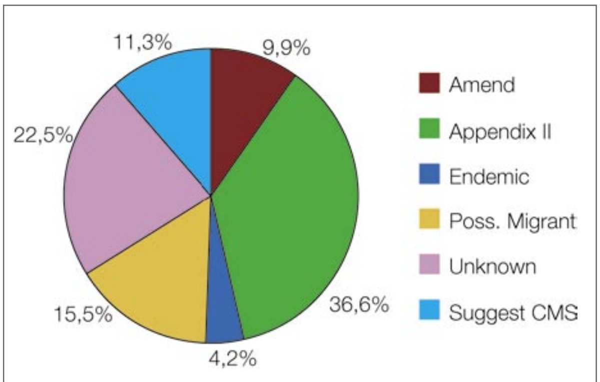

Figure 1: *Species summary. Of 71 odontocete species, migratory behaviour is unknown in 22.5%, 15.5% are possible migrants but there is insufficient knowledge to justify inclusion into CMS App. II, 4.2% are endemic (CMS does not apply) and 36.6% are already included in App. II. For a further 9.9% (7 species) certain sub-populations are included in App. II (but see recommendations below), and for 11.3% (8 species) inclusion into Appendix II is recommended (see below). From 46.5% of all small cetacean species already included into App. II of CMS, this fraction would thus increase to 57.8% (41 species) if all the recommendations listed below were accepted.*

(*Lipotes vexillifer*; China) – and therefore do not fall under a CMS category. The report showed that migration possibly occurred in the case of 11 species, but current knowledge on these species was judged "insufficient" so that no recommendation on inclusion into App. II of CMS could be expressed at present. These species are *Kogia breviceps*, *Ziphius cavirostris*, *Berardius arnuxii*, *Mesoplodon bidens*, *Mesoplodon layardii*, *Delphinus capensis* and *Delphinus tropicalis*, *Lagenorhynchus cruciger*, *Peponocephala electra*, *Feresa atenuata* and *Pseudorca crassidens*. A further 16 species (not including *C. hectori*, *P. sinus* or *L. vexillifer*) either do not migrate, or their migratory behaviour is to-date unknown (Table 1, see page 6)).

B. Recommended inclusion into appendix II of CMS

Inclusion in Appendix II of CMS is recommended for 8 small cetacean species and one subspecies:

Platanista gangetica minor
Because this subspecies formerly occurred, and some individuals possibly still occur, in riverine systems of both Pakistan and India, inclusion in Appendix II of CMS should be considered.

Hyperoodon planifrons
Listing by CMS should be considered, based on the fact that the animals seem to undertake migrations between the coasts of various range states and the open ocean. Potential range states include Chile, Argentina, the United Kingdom (Falkland and South Georgia), Norway (Bouvet Island), the Republic of South Africa, France (Kerguélen Islands), Australia, and New Zealand.

Sousa plumbea – Sousa chinensis
Movements of the species in areas such as the Indus and Ganges Deltas, as well as along the East African coast, in the Red Sea and the Persian Gulf are likely to involve international boundaries. Range States so far identified are Bahrain, Bangladesh, Comoros Islands, Djibouti, Egypt, Ethiopia, India, Iran, Iraq, Israel, Kenya, Kuwait, Madagascar, Martinique, Mozambique, Oman, Pakistan, Qatar, Saudi Arabia, Somalia,

South Africa, Sri Lanka, United Arab Emirates, United Republic of Tanzania and Yemen. Countries from within the range from which records have not been reported include Eritrea and Sudan, but the species may be expected to occur there.

Stenella frontalis
Satellite telemetry showed that the species is capable of moving considerable distances and stranding data show seasonal peaks. The home range and migratory movements may therefore cross many international boundaries. Range states include the US, Mexico, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guyana, Surinam, French-Guyana, Brazil, Cuba, Bahamas, Dominican Rep., Haiti, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Gabon, Rep. Congo, Dem. Rep. Congo, Angola and Namibia.

Stenella clymene
Although the species is poorly known, sightings at sea suggest a wide homerange, and individuals or groups may cross many international boundaries, especially in the Caribbean. Range states include the US, Mexico, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guyana, Surinam, French-Guyana, Brazil, Cuba, the Bahamas, Dominican Rep., Haiti, Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, and Gabon.

Lagenorhynchus obliquidens
The Pacific white-sided dolphin is a migratory species which crosses the boundaries of several countries on the east and west coasts of the Pacific Ocean. Range states include Mexico, the US, Canada, Russia, Japan, Taiwan, Korea and China.

Lissodelphis borealis
South-North as well as inshore-offshore movements have been reported from both sides of the Pacific. Range states concerned include Mexico, the US, Canada, Russia, Japan and possibly North and South Korea.

Lissodelphis peronii
Migrations along the coast of South America suggest that several national boundaries might be crossed. Inclusion in CMS Appendix II is recommended. Range states in South America are Peru, Chile, Argentina, Uruguay and Brazil, as well as the UK (Falkland/ Malvinas Islands).

Globicephala macrorhynchus
Recent results indicate a marked seasonality in the distribution of pilot whales in at least three areas: off southern California; in the eastern tropical Pacific; and off the coast of Japan. Range states concerned are the US, Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Columbia, Ecuador and Peru, as well as Russia, Japan, North and South Korea and China.

C. Recommended amendments to Appendix II of CMS

Extension of the stocks included in Appendix II, or of the distribution area included in Appendix II is recommended for 7 species:

Tursiops truncatus
Populations of *Tursiops truncatus* in the North and Baltic Seas, western Mediterranean and Black Sea are currently listed in Appendix II of CMS. However, because individuals of this species can either be resident, share a wide home range or migrate, it is suggested that all *Tursiops truncatus* populations should be included in App. II of CMS. Range states include most nations of South, Central and North America, Africa, Europe, Oceania, Australia and Asia: Ireland, the UK, The Netherlands, Belgium, France, Spain, Portugal, Marocco, Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Gabon, Rep. Congo, Dem. Rep. Congo, Angola, Namibia, Rep. South Africa, Mozambique, Madagascar, Tanzania, Kenya, Somalia, Djibouti, Yemen, Sudan, Egypt, Saudi-Arabia, Oman, Abu-Dabi, Katar, Bahrain, Iraq, Iran, Pakistan, India, Bangladesh, Sri Lanka, Myanmar, Thailand, Malaysia, Indonesia, Australia, New Zealand, Papua New Guinea, The Philippines, Cambodia, Vietnam, China, North and South Korea, Japan, Russia, the USA,

Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, Chile, Argentina, Uruguay, Brazil, French-Guyana, Surinam, Guyana, Venezuela, Santo Domingo, Haiti, Cuba, Belize, Jamaica, the Bahamas.

Stenella coeruleoalba
The eastern tropical Pacific population and the western Mediterranean population are included in Appendix II of CMS. However, observations off the coast of Japan also indicate migratory behaviour in these waters. Therefore, it is recommended that the West Pacific Stock also be included in App. II of CMS. Range states concerned in these waters are Japan, North and South Korea, the Peoples Republic of China and Taiwan.

Delphinus delphis
The North and Baltic Sea populations, the western Mediterranean Sea population, the Black Sea population and the eastern tropical Pacific population of *Delphinus delphis* are listed in Appendix II of CMS. However, recent data indicate that the species also migrates in the Strait of Gibraltar area (Range states: Spain, Portugal, Algeria, Morocco), along the coast of southern California (Range States US, Mexico), and in the Nova Scotia area (Range states US and Canada). It is therefore recommended that the species as a whole should be included in App. II of CMS, without restriction to particular stocks.

Lagenorhynchus albirostris
The North and Baltic Sea populations are listed in Appendix II of CMS. However, white-beaked dolphin abundance seems also to vary throughout the year off north-eastern North America, therefore this stock (Range states US and Canada) should also be included in CMS App. II.

Lagenorhynchus acutus
The North and Baltic Sea populations are listed in Appendix II of CMS, but inclusion of the NW Atlantic stock into CMS is recommended on the basis of observed migrational behaviour.

Grampus griseus
The North and Baltic Sea populations are included in Appendix II of CMS. However, populations off the East and West coasts of North America (Range states US, Mexico, Canada) also seem to migrate along the coast, and this is also the case for animals off SE South Africa. It is therefore suggested not to restrict the inclusion into CMS App. II to the populations mentioned, but to include *G. griseus* as a species.

Globicephala melas
The North and Baltic Sea populations have been listed in Appendix II of CMS. However, recent data on movements in the NW and NE Atlantic suggest that these stocks should also be included. Range states concerned are the US, Canada, Greenland, Iceland, Norway, Ireland and the UK.

D. Threats

The threats encountered by small cetaceans in their natural environment have been summarised from the individual species accounts and can be found on Table 2. These threats fall into 8 categories: unknown (insufficient knowledge of the species: 13 species), culling (killing of species by fishermen because these are judged to be unwanted competitors: 9 species), directed catches (47 species), by-catch (in sink-net, gillnet, driftnet and other fisheries targeted at various fish species: 50 species), overfishing (70% of the world fisheries are over-fished. This could be endangering 11 species of small cetaceans), pollution (e.g. contamination with heavy metals, organochlorines or ingestion of anthropogenic materials such as waste: 40 species), noise (avoidance reaction to vessel traffic or damage from military sonar systems: 2 species), habitat degradation (through the building of barrages and dams, siltation, heavy boat traffic: 17 species).

E. Future research

This review outlines, on a species by species basis, the state of our current knowledge on small cetaceans. While table 1 shows that in many cases our knowledge on individual species is insufficient or poor, considerable progress has been made, especially in the past few years, due to the development of new techniques in genetic research (taxonomy) and field research (behavioural ecology).

The threats faced by small cetaceans, however, bear the risk that we will not have the time required to gain a better understanding of their needs in a natural environment. Most marine areas are to-date largely influenced by man through fisheries, pollution and habitat degradation.

From the point of view of CMS, future research should therefore be aimed at mitigating adverse anthropogenic effects. Future cetacean research and international agreements should focus:

- on the development of alternatives for whale products, in order to reduce direct catches,
- on the development and improvement of reliable methods to reduce by-catch in all areas of fisheries,
- on the reduction of pollution at sea,
- on the environmental assessment of development projects, in order to minimise the effects of habitat degradation.

Acoustic methods seem to offer possibilities for alerting small cetaceans to boat traffic and prevent collision, for alerting them to gill nets and prevent entanglement and for keeping them out of heavily used areas such as harbours. On the other hand, acoustic pollution in the form of powerful sonar or geological exploration has been made responsible for mass strandings. It is the personal view of the author, therefore, that research into whale acoustics needs to be intensified, in order to reduce risks and make full use of potential possibilities.

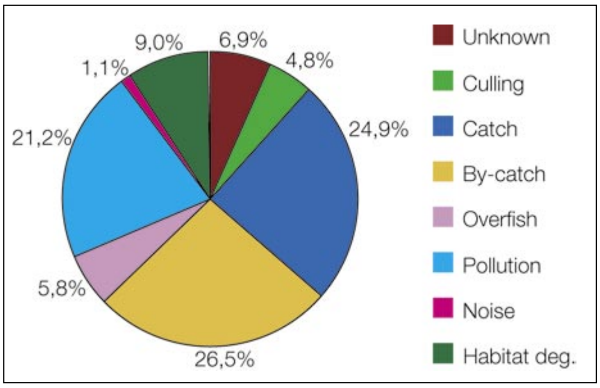

Figure 2: *Threats faced by small cetaceans in their natural habitat. The figure shows clearly, that the main cause for concern is still directed or accidental killing: 56.1% of all reported threats were culling, direct or accidental catch. Pollution amounted to 21.2% of all reported threats and habitat degradation accounted for 9%, followed by overfishing (5.8%) and noise (1.1%). In other words, human use of the seas and the coasts results in 37.1% or more than one third of all reported threats (n=188).*

Table 1
Tabular species summary

Genus	Species	Present Knowledge	IUCN Status	CITES	CMS App.	Migration	Populations included by CMS, Recommendations	Migratory behaviour
Berardius	*arnuxii*	insufficient	LR	nl	nl	Possible		north-south
Berardius	*bairdii*	poor	LR	App I & II	App II	Documented		inshore-offshore,
Cephalorhynchus	*commersonii*	fair	DD	nl	App II	Possible	South America	north-south
Cephalorhynchus	*eutropia*	poor	DD	nl	App II	Possible		north-south
Cephalorhynchus	*heavisidii*	fair	DD	nl	App II	Possible		Large home range
Cephalorhynchus	*hectori*	fair	EN, A1d, C1	nl	nl	None		resident in New Zealand
Delphinapterus	*leucas*	good	VU A1abd	nl	App II	Documented		N-S, in-offshore, into estuaries
Delphinus	*capensis*	insufficient	nl	nl	nl	Possible		Large home range
Delphinus	*delphis*	good	nl	nl	App II	Documented	ETP, West Med, North, Black and Baltic Seas **CMS extension?**	N-S, inshore-offshore, prey-dependent
Delphinus	*tropicalis*	insufficient	nl	nl	nl	Possible		Large home range
Feresa	*attenuata*	poor	DD	nl	nl	Possible		large home-range
Globicephala	*macrorhynchus*	good	LR	nl	nl	Documented	**CMS inclusion?** oceanography	nomadic, N-S, inshore-offshore,
Globicephala	*melas*	good	nl	nl	App II	Documented	North and Baltic Sea only, **CMS extension?**	inshore-offshore, N-S, oceanography
Grampus	*griseus*	fair	DD	nl	App II	Possible	North and Baltic Sea only, **CMS extension?**	north-south, inshore-offshore
Hyperoodon	*ampullatus*	poor	LR	App I&II	App II	Documented		north-south, inshore-offshore
Hyperoodon	*planifrons*	insufficient	LR	App I&II	nl	Documented	**CMS inclusion?**	north-south
Indopacetus	*pacificus*	insufficient	DD	nl	nl	Unknown		
Inia	*geoffrensis*	fair	VU A1cd	nl	App II	Documented		Various river systems
Kogia	*breviceps*	insufficient	nl	nl	nl	Possible		inshore-offshore
Kogia	*sima*	insufficient	nl	nl	nl	No		none
Lagenodelphis	*hosei*	fair	DD	nl	App II	Possible	SE Asia	inshore-offshore
Lagenorhynchus	*acutus*	fair	nl	nl	App II	Documented	North and Baltic Sea only, **CMS extension?**	north-south, inshore-offshore
Lagenorhynchus	*albirostris*	fair	nl	nl	App II	Documented	North and Baltic Sea only, **CMS extension?**	north-south, inshore-offshore
Lagenorhynchus	*australis*	fair	DD	nl	App II	Documented		north-south, inshore-offshore
Lagenorhynchus	*cruciger*	insufficient	nl	nl	nl	Possible		north-south, inshore-offshore
Lagenorhynchus	*obliquidens*	fair	nl	nl	nl	Documented	**CMS inclusion?**	north-south, , inshore-offshore
Lagenorhynchus	*obscurus*	good	DD	nl	App II	Documented		in-offshore, wide home-range, N-S
Lipotes	*vexillifer*	poor	CR A1bc, C2b, D	App I&II	nl	Possible		Local and long-range
Lissodelphis	*borealis*	fair	nl	nl	nl	Documented	**CMS inclusion?**	north-south, inshore-offshore
Lissodelphis	*peronii*	poor	DD	nl	nl	Possible	**CMS inclusion?**	north-south, inshore-offshore
Mesoplodon	*traversii*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*bidens*	poor	DD	nl	nl	Possible		north-south, inshore-offshore
Mesoplodon	*bowdoini*	insufficient	DD	nl	nl	Unknown		

Mesoplodon	*carlhubbsi*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*densirostris*	poor	DD	nl	nl	Unknown		
Mesoplodon	*europaeus*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*ginkgodens*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*grayi*	insufficient	DD	nl	nl	Unnkown		
Mesoplodon	*hectori*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*layardii*	insufficient	DD	nl	nl	Possible		North-South
Mesoplodon	*mirus*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*perrini*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*peruvianus*	insufficient	DD	nl	nl	Unknown		
Mesoplodon	*stejnegeri*	insufficient	DD	nl	nl	Unknown		
Monodon	*monoceros*	fair	DD	nl	App II	Documented		North-South, offshore-inshore
Neophocaena	*phocaenoides*	good	DD, EN	App I&II	App II	Documented		in-offshore, oceanography
Orcaella	*brevirostris*	good	DD	nl	App II	Documented		in-offshore, into and within rivers
Orcinus	*orca*	good	LR	nl	App II	Documented	Eastern NA and NP	North-South,
Peponocephala	*electra*	poor	nl	nl	nl	Possible		Oceanography
Phocoena	*dioptrica*	poor	DD	nl	App II	Possible		
Phocoena	*phocoena*	good	VU A1cd		App II	Documented	North-, Baltic-, & Black Seas, western North Atlantic	North-South, inshore-offshore
Phocoena	*sinus*	poor	CR C2b	App I&II	nl	no		
Phocoena	*spinipinnis*	poor	DD	nl	App II	Possible		North-South, inshore-offshore
Phocoenoides	*dalli*	good	LR	nl	App II	Documented		North-South, inshore-offshore
Platanista	*g. minor*	fair B1+2 abcde	EN A1acd,	App I&II	nl	Documented	**CMS inclusion?**	Main channels - tributaries
Platanista	*gangetica*	fair	EN A1acd	App I&II	App I&II	Documented		Main channels - tributaries
Pontoporia	*blainvillei*	fair	DD	nl	App I&II	Possible		Inshore-offshore, into estuaries
Pseudorca	*crassidens*	poor	nl	nl	nl	Possible		North-South, prey dependent
Sotalia	*fluviatilis*	fair	DD	App I&II	App II	Documented		inshore-offshore, in rivers and lakes
Sousa	*chinensis*	poor	DD	App I&II	App II	Documented		along coast, home-range
Sousa	*plumbea*	poor	nl	App I&II	nl	Documented	**CMS inclusion?**	North-South, along coast
Sousa	*teuszii*	poor	DD	App I&II	App II	Possible		North-South, Inshore-offshore
Stenella	*attenuata*	fair	LR	nl	App II	Documented	ETP, SE Asia	N-S, in-offshore, oceanograophy
Stenella	*clymene*	poor	DD	nl	nl	Possible	**CMS inclusion?**	Large home range
Stenella	*coeruleoalba*	good	LR	nl	App II	Documented	ETP, West Med, **CMS extension?**	N-S, in-offshore, oceanography
Stenella	*frontalis*	poor	DD	nl	nl	Documented	**CMS inclusion?**	in-offshore, across boundaries
Stenella	*longirostris*	fair	LR	nl	App II	Documented	ETP, SE Asia	Large home range
Steno	*bredanensis*	poor	DD	nl	nl	Unknown		
Tasmacetus	*shepherdi*	insufficient	DD	nl	nl	Unknown		
Tursiops	*aduncus*	insufficient	nl	nl	App II	Possible	Arafua/Timor Sea	
Tursiops	*truncatus*	fair	DD	nl	App II	Documented	Western Mediterranean, Black Sea, North+ Baltic Seas **CMS-Extension?**	N-S, large home range, currents
Ziphius	*cavirostris*	insufficient	DD	nl	nl	Possible		

Table 2
Anthropogenic Threats faced by small cetaceans

Genus	Species	Threats
Berardius	*arnuxii*	unknown
Berardius	*bairdii*	traffic, pollution, overfishing
Cephalorhynchus	*commersonii*	catch, by-catch, pollution
Cephalorhynchus	*eutropia*	catch, by-catch
Cephalorhynchus	*heavisidii*	catch, by-catch, habitat degradation
Cephalorhynchus	*hectori*	by-catch, pollution
Delphinapterus	*leucas*	pollution, noise, global warming, habitat degradation
Delphinus	*capensis*	presumably similar to *D. delphis*
Delphinus	*delphis*	catch, by-catch, culling, pollution, habitat degradation, overfis-hing
Delphinus	*tropicalis*	presumably similar to *D. delphis*
Feresa	*attenuata*	catch, by-catch, pollution
Globicephala	*macrorhynchus*	catch, by-catch, pollution
Globicephala	*melas*	catch, by-catch, overfishing, pollution
Grampus	*griseus*	catch, by-catch, culling, pollution
Hyperoodon	*ampullatus*	catch, habitat degradation
Hyperoodon	*planifrons*	catch, by-catch
Indopacetus	*pacificus*	unknown
Kogia	*breviceps*	by-catch, pollution
Kogia	*sima*	catch, by-catch, pollution
Lagenodelphis	*hosei*	catch, by-catch
Lagenorhynchus	*acutus*	catch, by-catch, pollution
Lagenorhynchus	*albirostris*	catch, by-catch, pollution
Lagenorhynchus	*cruciger*	unknown
Lipotes	*vexillifer*	habitat degradadtion
Lissodelphis	*borealis*	catch, by-catch, pollution
Lissodelphis	*peronii*	catch, by-catch
Mesoplodon	*traversii*	unknown
Mesoplodon	*bidens*	by-catch
Mesoplodon	*bowdoini*	unknown
Mesoplodon	*carlhubbsi*	catch
Mesoplodon	*densirostris*	catch, by-catch, pollution
Mesoplodon	*europaeus*	unknown
Mesoplodon	*ginkgodens*	catch
Mesoplodon	*grayi*	unknown
Mesoplodon	*hectori*	unknown
Mesoplodon	*layardii*	unknown
Mesoplodon	*mirus*	unknown
Mesoplodon	*perrini*	unknown
Mesoplodon	*peruvianus*	by-catch
Mesoplodon	*stejnegeri*	catch, by-catch
Monodon	*monoceros*	catch, pollution
Neophocaena	*phocaenoides*	catch, by-catch, habitat degradation, pollution

Genus	Species	Threats
Orcaella	*brevirostris*	catch, by-catch, habitat degradation, overfishing, pollution
Orcinus	*orca*	by-catch, culling, pollution, habitat degradation, overfishing
Peponocephala	*electra*	catch, by-catch
Phocoena	*dioptrica*	catch, by-catch
Phocoena	*phocoena*	catch, by-catch, pollution, habitat degradation
Phocoena	*sinus*	by-catch, pollution
Phocoena	*spinipinnis*	catch, by-catch, pollution
Phocoenoides	*dalli*	catch, by-catch, pollution, overfishing
Platanista	*g. minor*	catch, by-catch, culling, pollution, habitat degradation (dams)
Platanista	*gangetica*	catch, by-catch, culling, pollution, habitat degradation (dams)
Pontoporia	*blainvillei*	by- catch, pollution, habitat degradation
Pseudorca	*crassidens*	catch, by-catch, culling, polution
Sotalia	*fluviatilis*	catch, by-catch, habitat degradation, pollution
Sousa	*chinensis*	catch, by-catch, mass stranding, habitat degradation
Sousa	*plumbea*	catch, by-catch, mass stranding, habitat degradation
Sousa	*teuszii*	catch, by-catch, habitat degradation
Stenella	*attenuata*	catch, by-catch, culling, pollution
Stenella	*clymene*	catch, by-catch
Stenella	*coeruleoalba*	catch, by-catch, pollution, overfishing
Stenella	*frontalis*	catch, by-catch, pollution
Stenella	*longirostris*	catch, by-catch, pollution
Steno	*bredanensis*	mass stranding, by-catch, pollution
Tasmacetus	*shepherdi*	unknown
Tursiops	*aduncus*	unknown
Tursiops	*truncatus*	catch, by-catch, culling, pollution, overfishing
Ziphius	*cavirostris*	catch, by-catch, pollution, noise

3 Geographical Grouping of Species

This review considers 71 species of small cetaceans and is organised on a taxonomical basis (Rice, 1998). For the aims of CMS, a geographical classification is attempted here. Because cetaceans know no boundaries, I have grouped the range maps of the species accounts into 9 geographical categories. However, the categories are not exclusive and a species may be found in more than one area. Please see individual species accounts for details.

A. Worldwide Temperate and Tropical Oceans
Delphinus delphis
Delphinus capensis
Feresa attenuata
Globicephala macrorhynchus
Grampus griseus
Kogia breviceps
Kogia sima
Lagenodelphis hosei
Mesoplodon densirostris
Orcinus orca
Peponocephala electra
Pseudorca crassidens
Stenella attenuata
Stenella longirostris
Stenella coeruleoalba
Steno bredanensis
Tursiops truncatus
Ziphius cavirostris

B. North Atlantic Ocean
Delphinapterus leucas
Globicephala melas
Hyperoodon ampullatus
Lagenorhynchus albirostris
Lagenorhynchus acutus
Mesoplodon mirus
Mesoplodon bidens
Monodon monoceros
Orcinus orca
Phocoena phocoena

C. Tropical Atlantic Ocean
Mesoplodon europaeus
Sousa teuszii
Stenella frontalis
Stenella clymene

D. South Africa only
Cephalorhynchus heavisidii

E. South America only
Cephalorhynchus eutropia
Inia geoffrensis
Lagenorhynchus australis
Phocoena spinipinnis
Pontoporia blainvillei
Sotalia fluviatilis

F. General Pacific and Indian Ocean

Mesoplodon traversii (no map)
Mesoplodon gingkodens

G. North and Eastern Pacific Ocean

Berardius bairdii
Delphinapterus leucas
Lagenorhynchus obliquidens
Lissodelphis borealis
Mesoplodon carlhubbsi
Mesoplodon peruvianus
Mesoplodon perrini (no map)
Mesoplodon stejnegeri
Orcinus orca
Phocoena phocoena
Phocoena sinus
Phocoenoides dalli

H. Western Pacific and Indian Ocean

Cephalorhynchus hectori
Delphinus tropicalis
Indopacetus pacificus
Lipotes vexillifer
Mesoplodon mirus
Mesoplodon bowdoini
Neophocaena phocaeonoides
Orcaella brevirostris
Platanista gangetica gangetica
Platanista gangetica minor
Sousa plumbea
Sousa chinensis

I. Southern Ocean

Berardius arnuxii
Cephalorhynchus commersonii
Globicephala melas
Hyperoodon plaifrons
Lagenorhynchus obscurus
Lagenorhynchus cruciger
Lissodelphis peronii
Mesoplodon hectori
Mesoplodon grayi
Mesoplodon layardii
Orcinus orca
Phocoena dioptrica
Tasmacetus shepherdi

4 Taxonomy of the Toothed Whales (72 Species)

Suborder ODONTOCETI.

Family Physeteridae. Sperm Whale

Physeter macrocephalus	Sperm Whale, (not in species accounts)

Family Kogiidae. Pygmy Sperm Whales

Kogia breviceps	Pygmy Sperm Whale, p. 102
Kogia simia	Dwarf Sperm Whale, p. 105

Family Ziphiidae. Beaked Whales (21 species)

Ziphius cavirostris	Cuvier's Beaked Whale, p. 325
Berardius arnuxii	Arnoux's Beaked Whale, p. 16
Berardius bairdii	North Pacific Bottlenose Whale, p. 19
Tasmacetus shepherdi	Tasman Beaked Whale, p. 311

Subfamily Hyperoodontidae

Indopacetus pacificus	Indo-pacific Beaked Whale, p. 94
Hyperoodon ampullatus	Northern Bottlenose Whale, p. 85
Hyperoodon planifrons	Southern Bottlenose Whale, p. 91
Mesoplodon hectori	Hector's Beaked Whale, p. 174
Mesoplodon mirus	True's Beaked Whale, p. 178
Mesoplodon europaeus	Gervais' Beaked Whale, p. 168
Mesoplodon bidens	Sowerby's Beaked Whale, p. 158
Mesoplodon grayi	Gray's Beaked Whale, p. 172
Mesoplodon perrini	Perrin's Beaked Whale, p. 180
Mesoplodon peruvianus	Pygmy Beaked Whale, p. 181
Mesoplodon bowdoini	Andrew's Beaked Whale, p. 161
Mesoplodon traversii	Tarvers' Beaked Whale, p. 185
Mesoplodon carlhubbsi	Hubb's Beaked Whale, p. 163
Mesoplodon gingkgodens	Ginko-toothed Beaked Whale, p. 170
Mesoplodon stejnegeri	Stejneger's Beaked Whale, p. 183
Mesoplodon layardii	Layard's Beaked Whale, p. 176
Mesoplodon densirostris	Blainville's Beaked Whale, p. 165

Family Platanistidae. Indian River Dolphin

Platanista gangetica	Indian River-dolphin, p. 240	*P. g. minor* Indus River-dolphin
		P. g. gangetica Ganges River Dolphin

Family Iniidae. Amazon River-dolphin

Inia geoffrensis	Amazon River-dolphin, p. 96	*I. g. humboldtiana* Orinoco River-dolphin
		I. g. geoffrensis Amazon River-dolphin
		I. g. boliviensis Rio Madeira River-dolphin

Family Lipotidae. Chinese River-dolphin

Lipotes vexillifer	Yangtse River-dolphin, p. 142

Family Pontoporiidae. La Plata Dolphin

Pontoporia blainvillei	La Plata Dolphin, p. 248

Family Monodontidae. Beluga and Narwhal

Monodon monocerus	Narwhal, p. 186	
Delphinapterus leucas	Beluga, p. 37	

Family Delphinidae. Dolphins (36 species)

Cephalorhynchus commersonii	Commerson's Dolphin, p. 23	
Cephalorhynchus eutropia	Chilean Dolphin, p. 27	
Cephalorhynchus heavisidii	Heaviside's Dolphin, p. 30	
Cephalorhynchus hectori	Hector's Dolphin, p. 33	
Steno bredanensis	Rough-toothed Dolphin, p. 307	
Sousa teuszi	*Atlantic* Humpback Dolphin, p. 271	
Sousa plumbea	Indian Humpback Dolphin, p. 269	
Sousa chinensis	Pacific Humpback Dolphin, p. 262	
Sotalia fluviatilis	Tucuxi, p. 256	*S. f. guianensis* Atlantic Coast Tucuxi *S. f. fluviatilis* Amazon River Tucuxi
Tursiops truncatus	Bottlenose Dolphin, p. 315	
Tursiops aduncus	Indian Ocean Bottlenose Dolphin, p. 313	
Stenella attenuata	Pantropical Spotted Dolphin, p. 276	*S. a. graffmani* Eastern Pacific Coastal Spotted Dolphin *S. a. subsp.* Hawaiian Spotted Dolphin *S. a. subsp.* Eastern Pacific Offshore Spotted Dolphin
Stenella frontalis	Atlantic Spotted Dolphin, p. 294	
Stenella longirostris	Spinner Dolphin, p. 299	*S. l. longirostris* Cosmopolitan Spinner Dolpin *S. l. orientalis* Tropical Pacific Spinner Dolphin *S. l. centroamericana* Central American Spinner Dolphin
Stenella clymene	Clymene Dolphin, p. 283	
Stenella coeruleoalba	Striped Dolphin, p. 286	
Delphinus delphis	Shortbeaked Common Dolphin, p. 52	
Delphinus capensis	Longbeaked Common Dolphin, p. 49	
Delphinus tropicalis	Arabian Common Dolphin, p. 62	
Lagenodelphis hosei	Fraser's Dolphin, p. 110	
Lagorhynchus albirostris	Whitebeaked Dolphin, p. 119	
Lagorhynchus acutus	Atlantic Whitesided Dolphin, p. 114	
Lagorhynchus obliquidens	Pacific White-sided Dolphin, p. 130	
Lagorhynchus obscurus	Dusky Dolphin, p. 135	*L. o. fitzroyi* South American Dusky Dolphin *L. o. obscurus* South African Dusky Dolphin *L. o. subsp.* New Zealand Dusky Dolphin
Lagorhyncus australis	Blackchinned Dolphin, p. 123	
Lagorhyncus cruciger	Hourglass Dolphin, p. 127	
Lissodelphis borealis	Northern Right-whale Dolphin, p. 146	
Lissodelphis peronii	Southern Right-whale Dolphin, p. 151	
Grampus griseus	Risso's Dolphin, p. 80	
Peponocephala electra	Melonheaded Whale, p. 212	
Feresa attenuata	Pygmy Killer Whale, p. 64	
Pseudorca crassidens	False Killer Whale, p. 253	
Orcinus orca	Killer Whale, p. 204	
Globicephala melas	Longfinned Pilot Whale, p. 73	
Globicephala macrorhynchus	Shortfinned Pilot Whale, p. 67	
Orcaella brevirostris	Irrawaddy Dolphin, p. 198	

Family Phocoenidae. Porpoises (6 Species)

Neophocaena phocaenoides	Finless Porpoise, p. 192	*N. p. phocaenoides* Indo-pacific Finless Porpoise
		N. p. sunameri Chinese Finless Porpoise
		N. p. asiaorientalis Yangtse Finless Porpoise
Phocoena phocaena	Harbour Porpoise, p. 218	*P. p. phocaena* North Atlantic Harbour Porpoise
		P. p. subsp. Western North Pacific Harbour Porpoise
		P. p. vomerina Eastern North Pacific Harbour Porpoise
Phocoena sinus	Golfa de California Porpoise or Vaquita, p. 227	
Phocoena dioptrica	Spectacled Porpoise, p. 215	
Phocoena spinipinnis	Black Porpoise or Burmeister's Porpoise, p. 231	
Phocoenoides dalli	Dall's Porpoise, p. 234	*P. d. dalli* North Pacific Dall's Porpoise
		P. d. truei West Pacific Dall's Porpoise

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5 SPECIES ACCOUNTS

5.1 Berardius arnuxii (Duvernoy, 1851)

English: Arnoux´s beaked whale
German: Südlicher Schwarzwal
Spanish: Ballenato de Arnoux
French: Béradien d'Arnoux

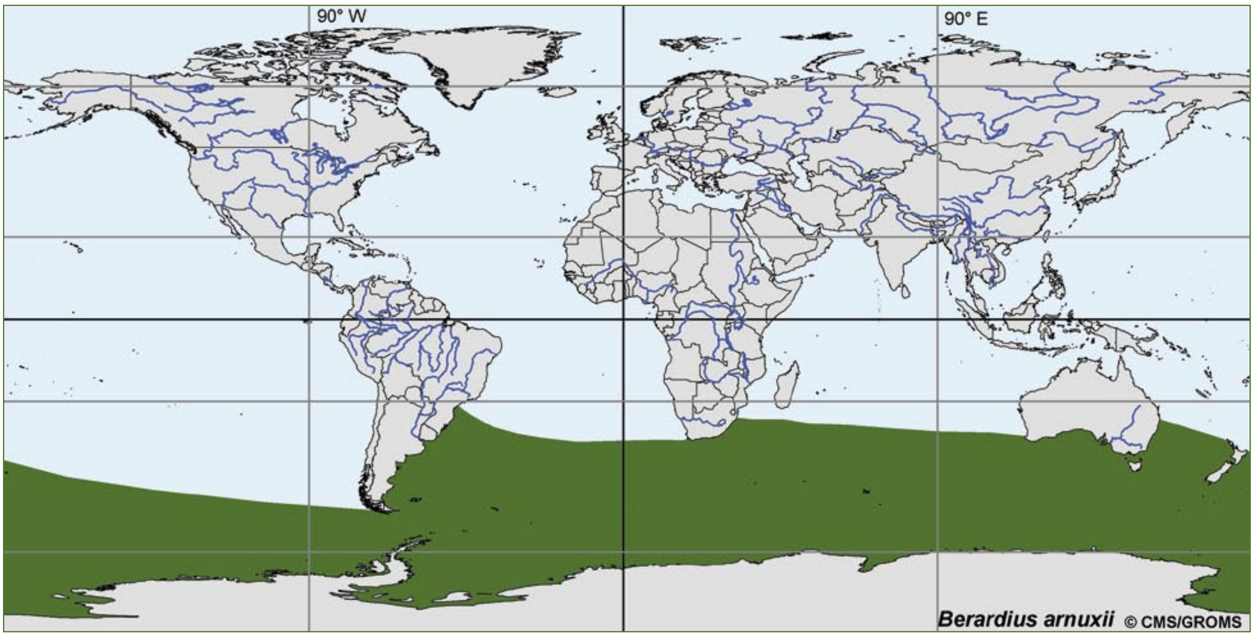
Drawing of Berardius arnuxii © Wurtz-Artescienza.

1. Description

The entire body is dark brown but the ventral side is paler and has irregular white patches. Tooth marks of conspecifics are numerous on the back, particularly on adult males. Adult size reaches from 8.5-9.75 m. The blowhole is crescent-shaped, the melon is small and has an almost vertical frontal surface, from which a slender rostrum projects (Kasuya, 2002).

2. Distribution

Arnoux's beaked whales are found circumpolar in the southern hemisphere from the Antarctic continent and ice edge (78°S) north to about 34°S in the southern Pacific including south eastern Australia (29°S) and northern New Zealand (37°S), southern Atlantic to Sao Paolo (24°S), and Indian Ocean; but nowhere within this range are they very well known or considered common. Most of the reported sightings are from the Tasman sea and around the Albatross Cordillera in the South Pacific. The overwhelming majority of stran-



Distribution of Berardius arnuxii: Waters around the Antarctic reaching northward to the shores of the Southern Hemisphere continents (mod. from Kasuya, 2002; © CMS/GROMS).

dings have been around New Zealand (Balcomb, 1989 and refs. therein; Jefferson et al. 1993; Rice, 1998). The species name has frequently been misspelled arnouxi or arnuxi.

The most northerly records are strandings, one from the coast of Sao Paulo state, Brazil (Martuscelli et al. 1996, 1995), the mouth of Rio de la Plata, Argentina, from the Kromme River Mouth, South Africa and from New South Wales, Australia (Paterson and Parker, 1994).

3. Population size

Arnoux's beaked whales seem to be relatively abundant in Cook Strait during summer (Cawardine, 1995). Sightings of large numbers have been reported recently along the western Antarctic coastal sector during the austral spring (Ponganis et al. 1995), similar to observations by Rogers and Brown (1999) for the eastern Antarctic sector.

Nothing is known about the life history of Arnoux's beaked whale, but it is presumably similar to that of Baird's beaked whale. They are apparently not as numerous as the northern form. Arnoux's beaked whales are usually very shy creatures; like their northern congeners, they are capable of diving for an hour or more, hence are difficult to observe and positively identify (in the southern hemisphere, identification could be confused with *H. planifrons* or *T. Shepherdi*). (Balcomb, 1989).

4. Biology and Behaviour

Habitat: Sightings have been associated with shallow regions, coastal waters, continental slopes or seamounts (Rogers and Brown, 1999 and refs. therein) and other areas with steep-bottomed slopes (Carwardine, 1995).

Behaviour: Hobson and Martin (1996) observed groups of Arnoux´s beaked whales near the Antarctic Peninsula and found that their breath-hold characteristics confirm *B. arnuxii* as one of the most accomplished mammalian divers, capable of swimming up to an estimated 7 km between breathing sites in sea ice. Whales moved to and from the observed lead, apparently able to find other breathing sites in what appeared to be unbroken ice. The species seems well adapted to life in ice-covered waters and may be able to exploit food resources inaccessible to other predators in the region.

Schooling: Arnoux's beaked whales are gregarious, often gathering in groups of 6-10 and occasionally up to 50 or more. A group of approximately 80 of these whales was observed in Robertson Bay, Antarctica in February 1986 by Balcomb (1989). It was closely followed for several hours, after which time it split up into subgroups of 8-15 animals which dispersed throughout the bay among windrows of loose pack ice. While near the surface, the whales frequently changed direction of travel as they swam at about 4 knots before diving deeply out of sight for long periods. Water depths in the locality of the whales in Robertson Bay ranged from 136 to 200 fathoms, and the surface water temperature was -0.8°C. Arnoux's beaked whales have been reported trapped in the ice, which may contribute to natural mortality.

Food: The feeding habits of Arnoux's beaked whales are assumed to be similar to those of their Northern Hemisphere relatives, Baird's beaked whales, thus consisting of benthic and pelagic fish and cephalopods (Jefferson et al. 1993).

5. Migration

Arnoux's beaked whales are known to enter packice and may live very close to the ice edge in summer, but are likely to move away in winter (Carwardine, 1995).

6. Threats

There has not been any substantial commercial hunting of this species, but some have been taken for scientific study (Jefferson et al. 1993).

7. Remarks

Although very little is known about this species, it has been classified as "Lower Risk, conservation dependent" by the IUCN and is listed in Appendix I of CITES. The species has not been listed by the CMS (see: "selected web-sites"). *B. arnuxii* also occurs in southern South America, therefore the recommendations iterated by the scientific committee of CMS for small cetaceans in that area (Hucke-Gaete, 2000) also apply (see "Appendix 1").

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5.2 Berardius bairdii (Stejneger, 1883)

English: Baird's beaked whale
German: Baird-Schnabelwal
Spanish: Zifio de Baird
French: Baleine à bec de Baird

Drawing of Berardius bairdii © Wurtz-Artescienza.

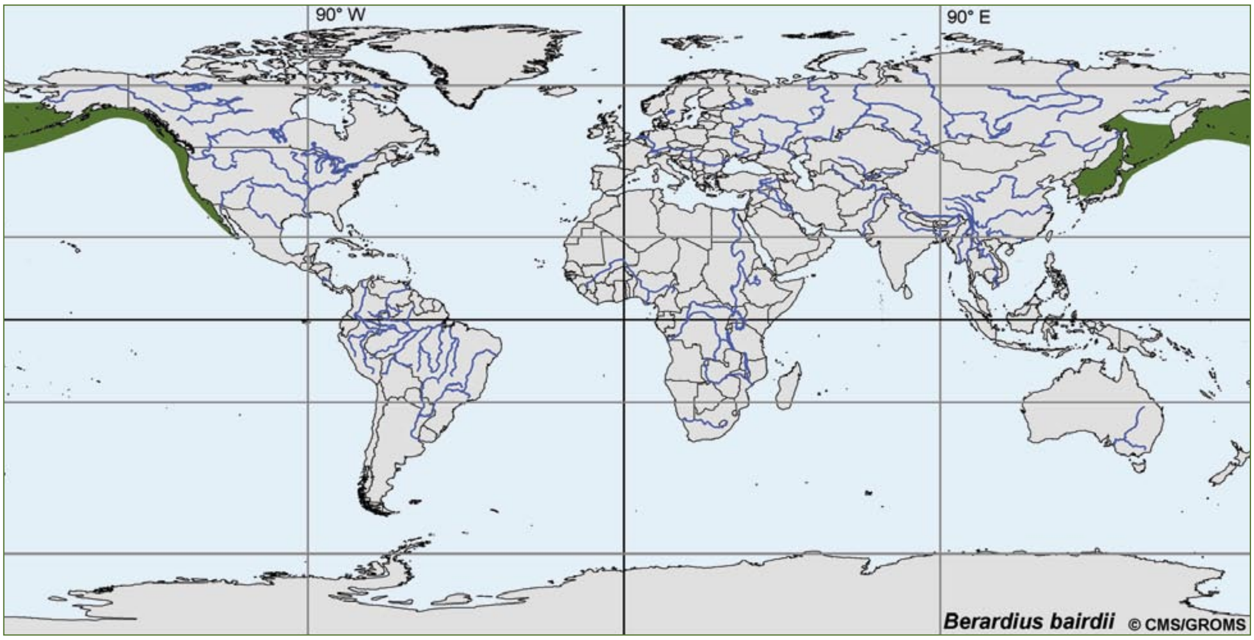
1. Description

The only known difference between the two allopatric taxa in this genus appears to be the substantially larger size of *B. bairdii*. More specimens of the latter form are needed to determine whether the difference is sufficient to warrant their status as a separate species, or whether *B. bairdii* should be reduced to a subspecies of *arnuxii* (Rice, 1998).

As in *B. arnuxii*, the entire body is dark brown but the ventral side is paler and has irregular white patches. Tooth marks of conspecifics are numerous on the back, particularly in adult males. Adult size reaches from 9.1 to 11.1 m. The blowhole is crescent shaped, the melon is small and has an almost vertical frontal surface, from which a slender rostrum projects (Kasuya, 2002).

2. Distribution

Baird's beaked whale is found in the temperate North Pacific, mainly in waters over the continental slope. Its range extends in the north from Cape Navarin (62°N) and the central Sea of Okhotsk (57°N), where they



Distribution of Berardius bairdii: across the northern Pacific from Japan, throughout the Aleutians, and southward along the coast to the southern tip of California (mod. from Kasuya, 2002; © CMS/GROMS).

occur even in shallow waters to the Komandorskiye Ostrova, Olyutorskiy Zaliv, St. Matthew Island, and the Pribilof Islands in the Bering Sea, and the northern Gulf of Alaska (Rice, 1998; Kasuya 2002).

In the south, it ranges on the Asian side as far as 34°S, and to 36°S in the Sea of Japan. On the American side it ranges south as far as San Clemente Island, north of Northern Baja California (Rice, 1998; Kasuya, 2002).

Vagrant to southwestern Golfo de California. Alleged sightings of *Berardius bairdii* across the central Pacific south as far as 25°N have not been verified by examination of specimens (they might be *Hyperoodon* sp. or *Indopacetus* sp; Rice, 1998).

The normal range of the species includes the waters north of 35°N, but there have been two records of mass strandings in the Sea of Cortez near La Paz (24°N), Baja California (Balcomb, 1989; Reyes, 1991 and refs. therein; Urban Ramirez and Jaramillo Legorreta, 1992). The species is not found in the East China Sea, Yellow Sea and western North Pacific (Kasuya and Miyashita, 1997).

There may be at least three stocks of Baird's beaked whales in the western North Pacific: a Sea of Japan stock that summers in the Sea of Japan and possibly remains isolated there year-round; an Okhotsk Sea stock distributed in waters near ice floes in that sea, and a Pacific coastal stock that probably inhabits continental slope waters between the fronts of the Kuroshio and Oyashio Currents, north of about 34°N (Balcomb, 1989; Reyes, 1991 and refs. therein). Acording to Kasuya and Miyashita (1997) there is no evidence to alter this three stock hypothesis. Other possible stocks are found in the Bering Sea and the eastern North Pacific, in the latter ranging from Alaska and Vancouver Island possibly to the Sea of Cortez (Balcomb, 1989; Reyes, 1991 and refs. therein).

3. Population size

Virtually nothing is known about the abundance of Baird's beaked whales, except that they are not as rare as was formerly thought (Balcomb, 1989). Population estimates for Japanese waters are 5029 for the Pacific coast, 1260 for the eastern Sea of Japan and 660 for the southern Okhotsk Sea (Kasuya, 2002). Sighting surveys on the whaling grounds indicate a population of several thousand Baird's Beaked Whales available to the fishery (Reeves and Mitchell, 1994).

4. Biology and Behaviour

Habitat: Though they may be seen close to shore where deep water approaches the coast, their primary habitats appear to be over or near the continental slope and oceanic seamounts (Jefferson et al. 1993). Baird's beaked whales are found in pelagic, temperate waters over 1,000 to 3,000 m deep, on the continental slope. Off the Pacific coast of Japan, these whales have been recorded in waters ranging between 23°C and 29°C, with a southern limit lying at the 15°C isotherm at a depth of 100 m. In the northern Okhotsk Sea the species has been recorded in waters less than 500 m deep, which could be explained by the availability of prey species in shallower waters at higher latitudes (Reyes, 1991 and refs. therein).

Behaviour: They are deep divers, capable of staying down for up to 67 min (Kasuya, 2002). From Japanese whaling data, it appears that males live longer than females and that females have no post-reproductive stage. There is a calving peak in March and April (Jefferson et al. 1993).

Schooling: Baird's beaked whales live in pods of 5 to 20 whales, although groups of up to 50 are occasionally seen. They often assemble in tight groups drifting along at the surface. At such times, snouts are often seen as animals slide over one another's backs (Jefferson et al. 1993). Dominance of adult males in the catches off Japan has been interpreted as an indication of segregation by sex and age. It was hypothesised that females and calves stay in offshore waters and that only adult males approach the coast. However, this is unlikely because of the lack of offshore sightings during summer fishing seasons. Other speculation referring to higher female mortality as well as to composition and behaviour of schools need to be verified with additional studies (Reyes, 1991 and refs. therein).

Food: Baird's beaked whales feed mainly on deep-water and bottom-dwelling fish, cephalopods, and crustaceans (Jefferson et al. 1993). Pelagic fish such as mackerel, sardines and saury may also be eaten (Reyes, 1991 and refs. Therein; Kasuya, 2002).

5. Migration

Information gathered from sightings on both sides of the North Pacific indicate that Baird's beaked whale is present over the continental slope in summer and autumn months, when water temperatures are highest. The whales move out from these areas in winter (Reyes, 1991 and refs. therein).

Tomilin (1957; in Balcomb, 1989) reported that in the Sea of Okhotsk and the Bering sea, Baird's beaked whales arrive between April and May, and are particularly numerous in summer. He reported they are not averse to travelling among the ice floes, going as far north as Cape Navarin (63°N).

Along the Pacific coast of Japan, a migrating population appears near the Boso Penninsula in May, reaches Hokkaido some time between July and August, and comes back again to Kinkazan offshore in the fall and then leaves Japan (Balcomb, 1989 and refs. therein). Kasuya (1986) noted that the Pacific coast population occurs predominantly from May to October along the continental slope north of 34°N in waters 1000-3000 m deep. Ohsumi (1983) and Kasuya and Ohsumi (1984; both in Balcomb, 1989) concluded that there is an apparent migration away from coastal Japan in winter months. Acording to Kasuya and Miyashita (1997) they appear in May along the Pacific coast of Japan, increase in density during summer on the continental slope (1,000-3,000 m depth) and north of 34°N and apparently leave in December, although there has been little sighting effort in December-April in their coastal summering ground. They are not confirmed in the deeper offshore waters in any season of the year and their wintering ground is still unknown.

In the eastern North Pacific, along the California coast, Baird's beaked whales apparently spend the winter and spring months far offshore, and move in June onto the continental slope off central and northern California, where peak numbers occur during the months of September and October. They have been seen or caught off Washington State between April and October and they were frequently seen by whalers operating off the west coast of Vancouver Island from May through October, with their peak occurrence being in August (Balcomb, 1989 and refs. therein).

6. Threats

Direct catches: Until the 1960s and 1970s, Baird's beaked whales in the eastern North Pacific were taken only by United States and Canadian whalers (in relatively small numbers). In the western North Pacific, there has been heavier exploitation by the Soviets and Japanese. In the past, Japan's coastal whaling stations took up to 40 Baird's beaked whales per year. Some Baird's beaked whales have been caught in Japanese salmon driftnets (Jefferson et al. 1993). Now the industry operates with a quota of 8 for the Sea of Japan, 2 for the southern Okhotsk Sea and 52 for the Pacific coasts (Kasuya 2002).

Incidental catch: None reported (Reyes, 1991).

Deliberate culls: None reported (Reyes, 1991).

Habitat degradation: Heavy boat traffic to and from Tokyo Bay is said to disturb the migration of Baird's beaked whales off the Pacific coast of Japan (Reyes, 1991 and refs. therein).

Pollution: The values of PCB/DDE ratios in specimens from the western North Pacific were found to be relatively lower than in offshore cetaceans from the same area. Although this led to suggestions about the restriction of offshore migration in Baird's beaked whales, the low level of pollutants could be related to the feeding habits of this deep-diving whale (Subramanian et al. 1988; Reyes, 1991 and refs. therein).

Overfishing: Some squid stocks have been overexploited off Japan, and fisheries for other squid species are expanding, which means that conflicts could arise in the future (Reyes, 1991 and refs. therein).

7. Remarks

National legislation protects the species in the United States, Canada and Russia, and fisheries no longer exist in these countries. Japan set an annual quota of 40 whales to be taken by the small-type fishery, a quota that was increased to 60 since the 1988 season (Reeves and Mitchell, 1994). Because the status of the population remains unknown, it is not possible to evaluate the effects of this catch level. *Berardius bairdii* is listed in Appendix I&II of CITES.

The IUCN categorises the species as "Lower Risk conservation dependent". The species has been listed by CMS in appendix II.

According to Reyes (1991) there has been no agreement in the IWC on whether or not it has the competence to classify or set catch limits for this species, even though it is included in the IWC definition of "bottlenose whale" (the only species so regulated is the northern bottlenose whale, *Hyperoodon ampullatus*). Although the IWC does not control the annual quota of Baird's beaked whales, it is assumed that the present catch levels over a short period would not seriously affect the population, but research is needed to obtain information that will allow a full assessment of its status

Range States are Canada, the United States, Mexico, Korea, Japan and Russia. In particular, the migration between waters of Japan and Russia occurs at the southern Okhotsk Sea and in waters off the Pacific coast of Hokkaido and the Kuril Islands. Further studies on stock identity, distribution, abundance, school structure and behaviour are needed to resolve some aspects of life history and migrations (Reyes, 1991 and refs. therein).

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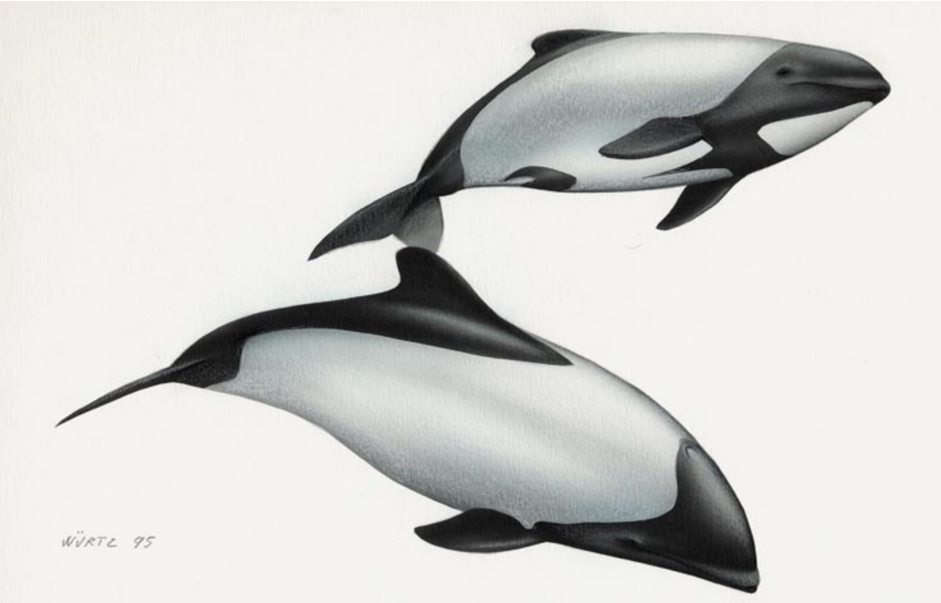
5.3 Cephalorhynchus commersonii (Lacépède, 1804)

English: Commerson's dolphin
German: Commerson-Delphin
Spanish: Delfín de Commerson
French: Dauphin de Commerson

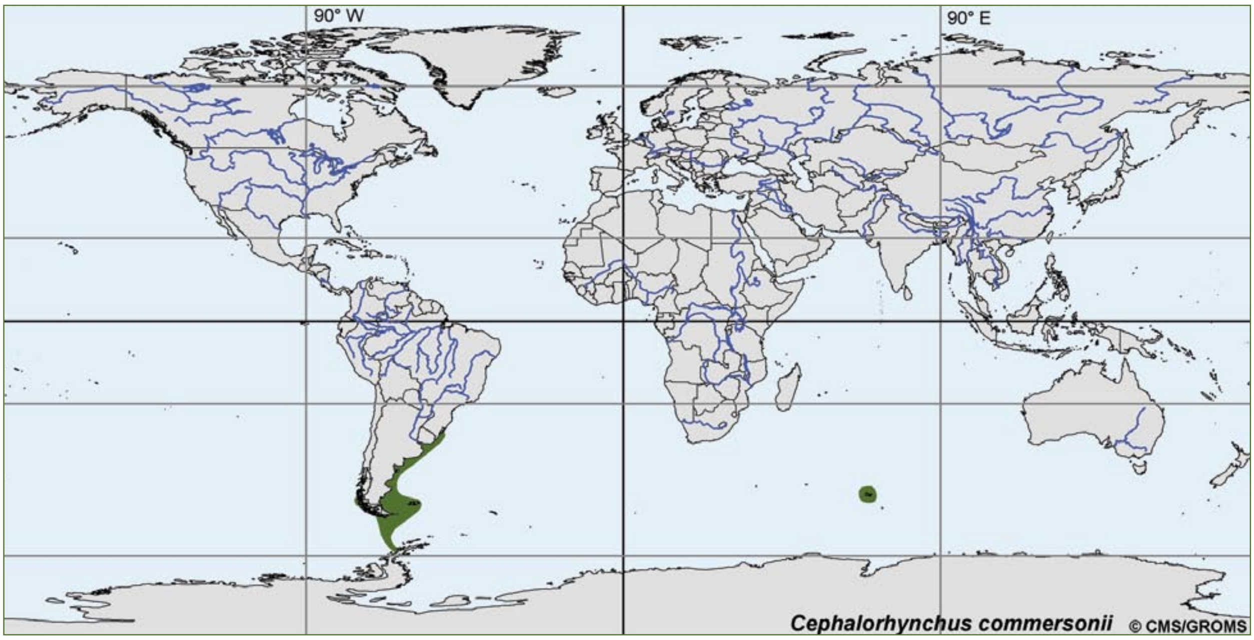


Drawing of Cephalorhynchus commersonii © Wurtz-Artescienza.

1. Description

Small, blunt-headed chunky dolphins without beak (and therefore often wrongly called porpoises) with rounded, almost paddle-shaped flippers. The dorsal fin is proportionally large and with a rounded, convex trailing edge (Dawson, 2002). Body colour is muted grey on black in the young, often appearing uniform. Later, this grey pales into white.

The head is black, with a white throat. The dorsal area from the fin backward is also black, and a black patch is located on the undersides, linking the flippers, which are also dark. The rest of the body is white apart from a black genital patch. Size ranges from 1.2 m to 1.7 m, and the heaviest animal recorded was 86 kg (Ward, 2001).



Distribution of Cephalorhynchus commersonii: southern South America, including the Falkland/Malvinas Islands, and Kerguélen Islands in the Indian Ocean (map mod. from Goodall, 1994; © CMS /GROMS)

2. Distribution

There are two populations separated by 130° of longitude, or 8,500 km. The animals at Kerguélen differ markedly from those in South America and merit designation as a separate subspecies, but they have not yet been named (Rice, 1998; Goodall, 1994). They are larger than the South American animals and are black, grey, and white (as opposed to black and white in South America; Carwardine, 1995).

C. commersonii – Falkland Islands / Islas Malvinas and the coastal waters of southern South America. The northernmost reliably documented limit of the South America population is from the Brazilian coast between 31 and 32°S (Pinedo et al. 2002). Range extends south into Drake Passage (61°50'S) as far as the South Shetland Islands, well within the range of *C. eutropia* (Rice, 1998). On the west coast of South America, specimens have been reported from Isla Chiloé, Chile (42°45 'S; Rice, 1998).

C. c. subsp. – Shallow coastal waters around all of the Iles Kerguélen in the southern Indian Ocean (Rice, 1998). No sightings or specimens have yet been reported from islands between South America and Kerguélen, such as Crozet, Heard, Amsterdam or St Paul (Goodal, 1994 and refs. therein).

3. Population size

It seems that Commerson's dolphin, despite the impacts it suffers (see below), is probably the most numerous member of the genus Cephalorhynchus (Dawson, 2002).

Leatherwood et al. (1988) conducted aerial surveys in the northern Strait of Magellan and estimated a minimum of 3,221 dolphins for that area. However, they did not observe Commerson 's dolphins in some areas where they had previously been recorded. It has been suggested that the reduced abundance of these dolphins in some areas in southern Chile may be due to depletion of the population or that the animals moved east in the Strait of Magellan. In both cases, the reason seems to be the extensive hunting pressure on this species in the past. However, single dolphins and groups of hundreds of animals have been sighted in the late 1980's and early 1990's from shores along the north coast of Tierra del Fuego. In other areas of Patagonia, concentrations seem to be near towns, probably a reflection of research effort rather than patchy distribution (Goodall, 1994 and refs. therein).

Venegas (1996) estimated the density of Commerson's dolphin during early summer (1989-1990) in the eastern sector of the Strait of Magellan, flying 79 transects corresponding to 1,320 km. The total estimated number within the study area was of 718 individuals. Venegas notes the strong difference between his figures and those of Leatherwood et al. (1988), which can be attributed to methodological factors as well as to the time of year.

The status of the population at the Kerguélen Islands is unknown, although Commerson's dolphins are now being reported frequently, owing to recent emphasis on research. By 1985, over 100 sightings were known and the largest group seen near the edge of the shelf contained about 100 dolphins (Goodall, 1994 and refs. therein; Robineau, 1989).

4. Biology and Behaviour

Habitat: Commerson's dolphins are found in cold inshore waters in open coasts, sheltered fjords, bays, harbours and river mouths, and they occasionally enter rivers. The offshore limit of the species range is said to be the 100 m isobath (Reyes, 1991; Carwardine, 1995). Within the Strait of Magellan, they prefer the areas with strongest currents, such as the Primera and Segunda Angostura (First and Second Narrows), where the current can reach or exceed 15 km/hr (Goodall, 1994). Off South America, Commerson's dolphins appear to prefer areas where the continental shelf is wide and flat; the tidal range is great, and temperatures are influenced by the cool Malvinas Current. Water temperatures in areas frequented by these dolphins range from 4°C to 16°C (South America) and 1°C to 8°C (Kerguélen). Around the Falkland / Malvinas and Kerguelen Islands as well as off mainland Argentina, Commerson's dolphins are often seen swimming in or at the edge of kelp beds (Reyes, 1991 and refs. therein).

Kerguélen sightings are most common within the Golfe du Morbihan where human activity is greatest and observation programmes are under way. There, the dolphins inhabit open waters, kelp-ringed coastlines and protected areas between islets (Goodall, 1994).

Reproduction: The breeding season is in the southern spring and summer, September to February (Jefferson et al. 1993).

Schooling: Groups are generally small, one to three animals being most common, although they do sometimes aggregate into groups of over 100. These are quick, active animals. They are known to ride bow waves and to engage in various types of leaps. Commerson's dolphins often swim upside down (Jefferson et al. 1993; Goodall, 1994; pers. obs.).

Food: Feeding is on various species of fish, squid, and shrimp. In South America, animals taken incidentally in shore nets were coastal feeders on at least 25 food items: mysid shrimp (22.5% of total diet), three species of small fish (20.4%), squid (14.1%), 17 species of other invertebrates, four species of algae, and miscellaneous plant remains. At Kerguélen, specimens taken in January (summer) were found to have been feeding mainly on 15 – 25 cm semipelagic chaennichthyid fish (*Champsocephalus gunnari*) and to a lesser extent on coastal benthic notothenids. Pelagic crustaceans (amphipods, hyperiids and euphausiids), benthic crustaceans (*Halicarcinus planatus*), and, in one specimen, numerous annelid tubes and asciadians were also found in stomachs (Goodall, 1994 and refs. therein). Commerson's dolphins thus appear to be opportunistic, feeding primarily near the bottom (Jefferson et al. 1993; Reyes, 1991; Goodall, 1994; Clarke and Goodall, 1994).

5. Migration

South America. There are few data on movements or migrations. At least some dolphins have been seen throughout the year in most areas, although fishermen claim that most disappear during the winter to return in November. The dolphins may follow the fish (róbalo, merluza) which move offshore during winter. A low count of Commerson's dolphins in the Strait of Magellan in late autumn may be accounted for by such movements. Certainly the number observed is larger in summer (Goodall, 1994 and refs. therein; Venegas, 1996).

Kerguélen. Preliminary observations carried out throughout the year indicate that, although some dolphins stay, most move out of the Golfe du Morbihan from June to December (winter and spring). Nevertheless, as dolphins were seldom found over the adjacent continental shelf, they may move to other parts of the archipelago (Goodall, 1994 and refs. therein).

6. Threats

Direct catch: In recent years, various species of small cetaceans, mainly Commerson's dolphins and Peale's dolphins, have been harpooned and used as bait in the southern king crab ("centolla") fishery in both Argentina and Chile. Because the centolla is overfished in the Magellan region, the fishing effort has shifted to the false king crab which is exploited principally farther west in the channels. Commerson's dolphins are not found here, but they are abundant in the eastern part of the Strait. In Argentina the crab fishery operates in the Beagle Channel, where few Commerson's dolphins exist. However, some animals have been killed for sport (Reyes, 1991 and refs. therein). Some Commerson's dolphins have been captured live in recent years, and the species appears to have done relatively well in captivity (Jefferson et al. 1993).

Incidental catch: Off southern South America, this is the odontocete species most frequently taken in fish-ing nets, perhaps due to its coastal habits and narrow-band sounds. It is taken most often in fairly wide-mesh nets and is apparently able to avoid nets with fine mesh. Although the exact size of the by-catch is unknown, at least 5-30 Commerson's dolphins die each year in nets set perpendicular to the shore in eastern Tierra del Fuego alone. Dolphins are also taken in this type of fishing in the Argentinean provinces north of Tierra del Fuego and in the eastern Strait of Magellan and Bahía Inútil in Chile. A few are taken by trawlers offshore in northern Patagonia (Goodall, 1994 and refs. therein; Crespo et al. 1995). Because the dolphins are used as bait, the fishers have no motive to avoid areas where captures occur and may favour them (Dawson, 2002).

Pollution: Low levels of chlorinated hydrocarbons (DDT, PCB and HCB) were found in blubber of Ker-guélen dolphins, confirming the presence of contaminants in oceans far from the main sources of pollution. However, these levels were 10-100 times less than those of cetaceans in the North Atlantic (Goodal, 1994).

7. Remarks

Commerson 's dolphins may have been seriously affected by the illegal take for bait in the crab fishery. It seems that the pressure on this species has been reduced in the late 1980's. However, the incidental mortality in gillnets and other fishing operations continues and represents the major threat to this dolphin (Reyes, 1991).

Regulations for small cetaceans in Argentina and Chile date back to 1974 and 1977, respectively. Permits are required for any taking, but in practice enforcement applies only to live-captures. In particular, enforcement is difficult in southern Chile, where the characteristics of the area preclude appropriate control. There does not appear to be any legislation protecting small cetaceans in the Falkland/Malvinas Islands, although some proposed conservation areas may protect the habitat. In the case of live-captures, Argentina banned this activity until more information on the species would be available (Reyes, 1991 and ref. therein).

Cephalorhynchus commersonii is listed in the IUCN Red list as "Data defficient". The South American population is listed in Appendix II of CMS (see "selected web-sites"). Range States for these populations are Argentina, Chile, Great Britain and France. These countries have legislation that protects small cetaceans, but co-operative research efforts should be developed for further protection of this and other species affected by the fishery. In a recent CMS-review (Hucke-Gaete, 2000) the main reasons for a regional conservation agreement on southern South-American small cetaceans including *C. commersonii* were developed (see Appendix 1).

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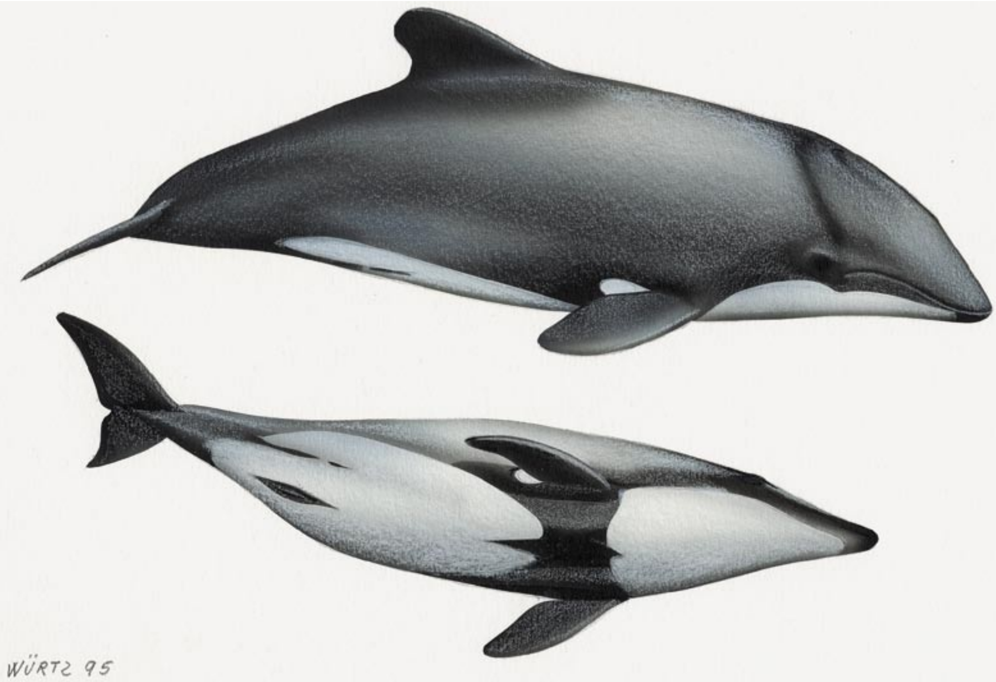
5.4 Cephalorhynchus eutropia (Gray, 1846)

English: Chilean dolphin
German: Chile-Delphin
Spanish: Delfín Chileno
French: Dauphin du Chili



Drawing of Cephalorhynchus eutropia © Wurtz-Artescienza.

1. Description

Small, chunky and blunt-headed dolphins without beak (and therefore often wrongly called porpoises). The flippers are rounded and almost paddle-shaped. The dorsal fin is proportionally large and with a rounded, convex trailing edge, like a Mickey Mouse ear (Dawson, 2002). Basically grey, with a lighter grey 'cap' over the melon. The lips are white, as is the throat and belly, and behind each flipper there is a white 'armpit'.

Distribution of Cephalorhynchus eutropia: coastal waters of Chile and southern Argentina (mod. from Goodall, 1994; © CMS/GROMS).

The flippers are linked by a grey band across the throat, which is often shaped like a rhombus in the centre. Around 1.7 m long, mass reaches 60 kg (Ward, 2001).

2. Distribution

Chilean dolphins occur in coastal waters of southern South America from Valparaiso, Chile (33°S), south to Isla Navarino, Beagle Channel, and Cape Horn, Argentina (55° 15'S; Rice, 1998). *C. eutropia* is restricted to cold, shallow, coastal waters. Its distribution seems to be continuous, though there seem to be areas of local abundance, such as off Playa Frailes, Valdivia, Golfo de Arauco, and near Isla de Chiloé (Dawson, 2002). The species is known to enter Rio Valdivia and other rivers (Carwardine, 1995).

The easternmost sighting of *C. eutropia* was near the eastern mouth of the Strait of Magellan. Although it is mostly allopatric with Commerson's dolphin, *Cephalorhynchus commersonii*, the ranges of the two species may overlap slightly in the Strait of Magellan and Beagle Channel, on the border with Argentina (Goodall, 1994).

3. Population size

The total population appears to be very small (low thousands at most). Suggestions that the species is becoming very rare are worrying and impossible to refute without dedicated survey work (Dawson, 2002).

Cephalorhynchus eutropia has been called a rare dolphin, but perhaps it has been seen rarely because of the lack of boat traffic and of trained observers in the channels, and because of its shy, evasive behaviour. Research in Chile has revealed that it may be locally abundant in areas such as Valdivia, the Golfo de Arauco and near Chiloé, where groups of 20-50 or more animals have been seen. Certain local populations seem to be resident year round, especially near Chiloé (Goodall, 1994).

Chilean dolphins represented 16% of the cetacean sightings, captures, and strandings in an 8-year study between Coquimbo (30°S) and Tome (36°37'S). However, most sightings occurred on an opportunistic basis as few ship surveys and no aerial surveys have been carried out. There are indications that the Chilean dolphin may be fairly common (Goodall, 1994).

4. Biology and Behaviour

Habitat: According to Goodall (1994) the Chilean dolphin inhabits two distinct areas: (1) the channels from Cape Horn to Isla Chiloé and (2) open coasts, bays and river mouths north of Chiloé, such as waters near Valdivia and Concepción. It seems to prefer areas with rapid tidal flow, tide rips, and shallow waters over banks at the entrance to fjords. The dolphins readily enter estuaries and rivers. Most sightings have been near shore and therefore it is considered a coastal species, although little scientific survey effort has been made in offshore waters. The Chilean dolphin is thought to occur more or less continuously throughout its range and may associate with *Lagenorhynchus australis* (Goodall, 1994; Jefferson et al. 1993). Carwardine (1995) reports that they are often seen among breakers and swells very close to shore. Animals in the southern part of the range tend to be more wary of boats and difficult to approach; in the north, they have been known to swim over to boats and may bow-ride.

Schooling: The usual group size is from two to 10 dolphins and most observers have reported sighting only two or three animals at one time. Nevertheless, groups of 20-50 or more dolphins are seen at times, especially in the northern part of the range, and early investigators wrote of "great numbers". Such observations may represent occasional aggregations of smaller groups. The largest concentration ever reported was 15 miles long, possibly 4,000 animals, which moved north past Queule (39°22'S), hugging the shore (Goodall, 1994).

Food: *C. eutropia* feeds on crustaceans (*Munida subrugosa*), cephalopods (*Loligo gahi*), and fish, such as sardines (*Strangomera bentincki*), anchoveta (*Engraulis ringens*), róbalo (*Eteginops macrovinus*) and the green alga *Ulva lactuca*. Dolphins near a salmon hatchery on Chiloé played with salmon and may have eaten young released salmon (Goodall, 1994 and refs. therein).

5. Migration

Nothing is known of the movements or migration in this species. Numerous observations in the Valdivia area suggest that there is at least one resident pod, but individual animals have not been identified to confirm this. Sightings throughout the year in the northern part of the range (north of Chiloé) and during most months in the central and southern section have been reported (Goodall, 1994).

6. Threats

Direct catch: Although killing of dolphins is prohibited by law, they are taken for bait, and it has been claimed that they were also used for human consumption. Fishermen in coastal areas north of Chiloe harpoon or used those taken incidentally in their nets, as bait for fish caught on long lines with many hooks, for swordfish fished with individual hooks, or for crab ring nets. From Chiloé south, and especially in the Magellan region, dolphins are taken along with penguins, sheep, seals, sealions, other marine birds, and fish for bait for the lucrative "centolla" (southern king crab, *Lithodes santotta*) and "centolion" (false king crab, *Paratomis granutosa*) fishery. The larger crab-processing companies provide bait (in insufficient quantities) for their fishermen, but independent fishermen who supply smaller companies harpoon or shoot their own bait and claim that the crab prefer dolphins over other animals and birds. It has been estimated for the 1980's that two Chilean dolphins were taken per week per boat, and that as many as 1,300-1,500 dolphins were harpooned per year in the area near the western Strait of Magellan. Fishing areas since then have moved farther north and south, but the captures of dolphins for bait continue (Goodall, 1994). Although hunting is now illegal, fishersmen in the area are poor and enforcement of the law in remote areas is practically impossible. A dependable alternative supply of inexpensive bait is needed. (Dawson, 2002). The actual numbers taken remain unknown.

Incidental catch: Incidental catch probably occurs throughout its range, especially in the north, where dolphins can become entangled in several kinds of nets. No calculation has been made of the extent of incidental catch in Chile, but at Queule, near Valdivia, Chilean dolphins account for 45.8% of the dolphins taken in gill nets set from some 30 boats. This implies a catch of some 65-70 animals per year at this one port (Goodall, 1994, and refs. therein).

7. Remarks

This species is insufficiently known with respect to all aspects of its biology and potential threats. It is listed as "Data Deficient" by the IUCN.

Cephalorhynchus eutropia is included in Appendix II of the CMS: the range of this species may extend beyond the Chilean border into Argentinean waters in the Beagle channel and at the entrance of the Strait of Magellan near Cabo Virgenes and Cabo Espiritu Santo. Collection of by-catch and sighting data is strongly needed. In a small population of slow breeding animals, even a very low level of incidental catch can be enough to continue the decline (Dawson, 2002).

In a recent CMS review (Hucke-Gaete, 2000; see Appendix 1) the main reasons for a regional conservation agreement on southern South-American small cetaceans including *C. eutropia* were developed.

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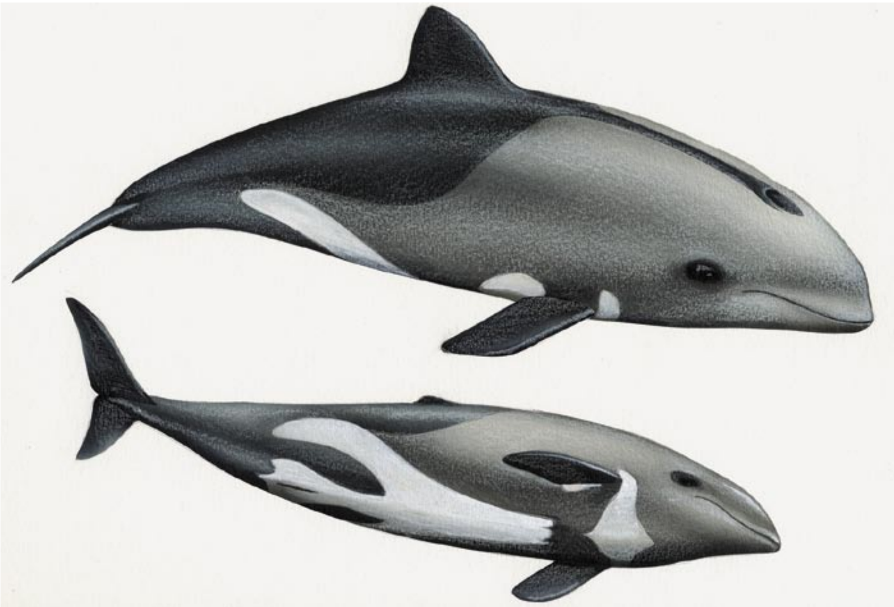
5.5 Cephalorhynchus heavisidii (Gray, 1828)

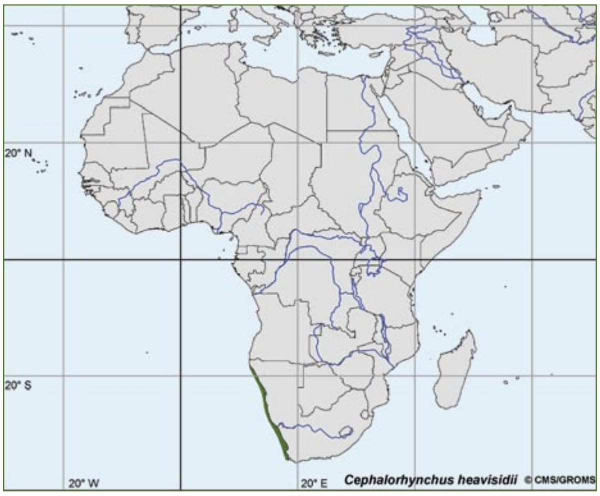
English: Heaviside's dolphin
German: Heaviside-Delphin
Spanish: Delfín del cabo
French: Céphalorhynque du Cap



Drawing of *Cephalorhynchus heavisidii* © Wurtz-Artescienza.

1. Description

All dolphins of the genus are small, blunt-headed and chunky. Because they don't have a beak, they are often wrongly called porpoises. Their flippers are rounded and almost paddle-shaped. The dorsal fin is proportionally large and triangular (Dawson, 2002). The fore half of the body is uniformly grey, with the dorsal cape, fin, flanks and keel being dark blue-black. A similarly-coloured stripe runs from the blowhole to the cape. The flippers and eye patch are the same colour.



Distribution of Cephalorhynchus heavisidii (mod. from Best and Abernethy, 1994): cold coastal waters from central Namibia to southern South Africa; © CMS/GROMS.

The underside is white, with white 'armpits' behind the flippers and a rhombus shape on the chest. A finger-shaped patch extends from the belly along each flank. Adults grow to around 1.7 m long and weigh around 60–70 kg (Ward, 2001).

2. Distribution

Heaviside's dolphins range in close inshore waters of south-western Africa, from northern Namibia (17°09'S) south to Cape Point in Cape Province (34°21'S) (Rice, 1998; Dawson, 2002). The range is restricted and fairly sparsely populated throughout. *C. heavisidii* occurs only along approximately 1,600 km of shoreline (Carwardine, 1995). There are no authenticated sightings or beach-cast specimens of the species east of Cape Point, and this seems to mark the southern and eastern limit of distribution. The northern limit is less well defined, as records extend along the entire west coast of South Africa and Namibia. As the cetacean fauna of Angola is very poorly known, it is uncertain how much farther north the distribution of Heaviside's dolphin might extend (Best and Abernethy, 1994).

3. Population size

No reasonable estimate is possible from the available data. The species is by no means rare, although it is not abundant anywhere within the known range. Surveys off the coast of southern Africa yield approximate densities of 4.69 sightings per 100 nautical miles within 5 nm of the coast, with relatively fewer sightings further offshore (Reyes, 1991 and refs. therein). Griffin and Loutit (1988, in Best and Abernethy, 1994), state that Heaviside's dolphins are the cetaceans most frequently seen from the Namibian coast.

4. Biology and Behaviour

Habitat: As other species in the genus, it is a coastal, shallow water animal (Jefferson et al. 1993; Reyes, 1991). It is mostly seen in coastal waters, within 8–10-km of shore and in water less than 100 m deep. Surveys within 8 km of the coast have shown low population densities of around 5 sightings per 160 km; sightings dropped dramatically further offshore, and no animals were seen in water deeper than 200 m. *Cephalorhynchus heavisidii* seems to be associated with the cold, northward-flowing Benguela Current. Some populations may be resident year-round (Carwardine, 1995; Reyes, 1991; Rice and Saayman, 1984). Heaviside's dolphins have been found within a wide range of surface temperatures (9-19°C), but most sightings (87.2 %) were in water of 9-15°C (Best and Abernethy, 1994).

Behaviour: Little is known about the behaviour of this species. It is generally undemonstrative and appears to be shy. Reactions to vessels vary, but it is known to approach a range of boats and to bow-ride and wake-ride; some animals have been seen "escorting" small vessels for several hours at a time. Limited observations suggest that at least some groups have restricted home ranges and probably do not stray far from these areas (Carwardine, 1995).

Schooling: Heaviside's dolphins are usually found in small groups of from one to 10 animals, with two being the most common number. Mean group size for 149 confirmed sightings made on scientific cruises was 3.2 animals. On some occasions two groups can be found in close association, and it is possible that amalgamation into larger groups may occur occasionally: the sighting of 30 animals may represent such an occasion (Best and Abernethy, 1994 and refs. therein).

Food: Stomach contents are available from 17 animals, and included a minimum total of 4928 identifiable food items. Demersal fish such as hake (*Merluccius capensis*) and kingklip (*Genypterus capensis*) formed 49 % and octopods 22 % by weight of the organisms identified, while gobies (*Sufftogobius bibarbatus*) and squid (*Loligo rejnaudi*) were also important components. Heaviside's dolphin seems to feed on bottom-dwelling organisms, demersal species that may migrate off the bottom (even to the surface) at night, and pelagic species that can be found from the surface to near the sea floor on the continental shelf (Best and Abernethy, 1994 and refs. therein).

5. Migration

Movements of this species are not well known. Repeated sightings of individually recognisable specimens (including a pure white animal) over a long period indicate that certain groups may be resident in some areas (Reyes, 1991 and refs. therein). However, Best and Abernethy (1994) summarise "whether Heaviside's dolphins reside year-round in particular areas is an open question". An immature male *C. heavisidii* marked with a spaghetti tag was recaptured about 85 nautical miles north of the marking position. Although little can be deduced from a single incident, this record suggests a relatively small amount of overall movement over a 17-month period (Best and Abernethy, 1994 and refs. therein), and a relatively wide home range, which may easily cross international boundaries.

6. Threats

Direct catch: Although fully protected legally, directed takes, with hand-thrown harpoons or guns of about 100 dolphins per year, including Heavisides dolphin and two other species, have been reported (Reyes, 1991 and refs. therein).

Incidental catch: Some Heaviside's become entangled in a variety of inshore fishing nets off South Africa and Namibia each year, and small numbers may be taken with hand-held harpoons or rifles for human consumption (Carwardine, 1995). Estimated total kills of dolphins in 7,013 sets off Namibia in 1983 were 67 (*C. heavisidii* and *Lagenorhynchus obscurus* combined), whereas 57 were killed in South Africa. Other reported sources of incidental mortality were set nets in waters close to the shore of Namibia, although data on catch rates and mortality are lacking. There are unconfirmed reports of specimens taken in a bottom trawl fishery, but a drift net shark fishery does not seem to pose a threat to the dolphin population (Reyes, 1991 and refs. therein). Heaviside's dolphins are also known to be caught accidentally in beach-seine nets. Up to seven dolphins have been reported to be entrapped and beached during one net haul and although it is likely that many of the animals landed in this fishery are returned to the sea alive, some mortality may occur (Best and Abernethy, 1994).

Although presently probably able to sustain mortalities following interactions with commercial fishing gear, Heaviside's dolphins may become negatively impacted should fishing activities increase (Peddemors, 1999).

Deliberate culls: None reported (Reyes, 1991).

Habitat degradation: Taking into account the relatively small home range of the species and its restricted distribution in coastal waters, pollution and boat traffic may be causes for concern.

7. Remarks

Heaviside's dolphin is protected within the 200-mile Exclusive Fishery Zone (EFZ) of South Africa, where all delphinids are protected under the Sea Fisheries Act of 1973. Similar protection is given In Namibia's 12-mile EFZ. Permits were formerly given for the operation of set netting off the Namibian coast but this has been prohibited by the Government since 1986. The main threats to the species are incidental mortality in several fishing operations, possibly pollution and boat traffic, and development of fisheries in the region (Reyes, 1991 and refs. therein).

Cephalorhynchus heavisidii is listed as "Data Deficient" by the the IUCN. It is included in Appendix II of the CMS.

Although its range is restricted to a small part of the south-western African coast, observations by Rice and Saayman (1989) show that relatively large groups are present regularly in waters Involving the national boundaries of Namibia and South Africa, the two known Range States (Reyes, 1991 and refs. therein).

Further information is needed on probable distribution of the species in Angola, whose status as a Range State needs further consideration. Information on distribution and abundance is urgently needed. More information on the nature and extent of catches is required to assess the status of this species (Reyes, 1991 and refs. therein).

More research emphasis should in future also be placed on possible detrimental interactions due to overfishing of prey stocks. Increased commercial fishing pressure will inevitably also increase interactions between the fishery and Heaviside dolphins, which are considered to be vulnerable (Peddemors, 1999).

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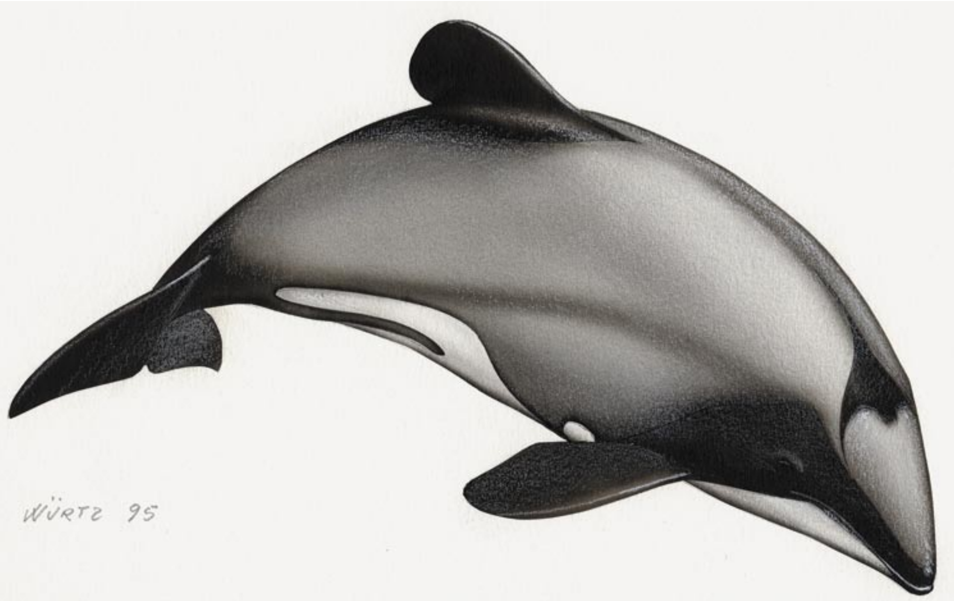
5.6 Cephalorhynchus hectori (P.-J. van Beneden, 1881)

English: Hector's dolphin
German: Hector-Delphin
Spanish: Delfín de Héctor
French: Dauphin d'Hector

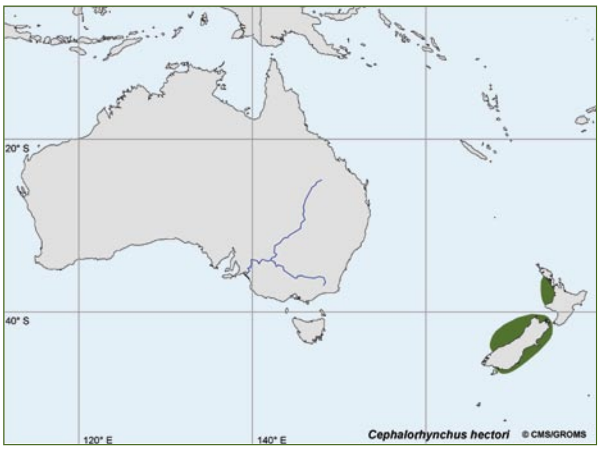


Drawing of Cephalorhynchus hectori © Wurtz-Artescienza.

1. Description

Similar to the other representatives of the genus, these are small, blunt-headed chunky dolphins without beak (and therefore often wrongly called porpoises) with rounded, almost paddle-shaped flippers. The dorsal fin is proportionally large and with a rounded, convex trailing edge, like a Mickey Mouse ear (Dawson, 2002). The colour scheme of the Hector's dolphin is well defined with areas of grey, black and white.

The sides of the head, the flippers, dorsal fin and the tail are all black. The belly is white except for a small area between the flippers. There is also a distinctive finger-like swoosh of white that extends from the belly, along the flanks towards the tail. The rest of the body is grey. An adult Hector's dolphin grows to a length of 1.2 to 1.4 metres (KCC, 2002).



Distribution of Cephalorhynchus hectori (mod. from Slooten and Dawson, 1994): coastal waters of New Zealand, especially South Island and the western coast of North Island; © CMS/GROMS.

Pichler et al. (1998) used mitochondrial DNA to determine that *C. hectori* was subdivided into three sub-populations: North island, west and east coast of South island. Such a marked segregation of maternal lineages across a small geographic range is unusual among cetaceans. The low rate of female dispersal, as indicated by this mitochondrial DNA structure, could increase the vulnerability of local populations to extinction due to fisheries-related mortality (see below).

2. Distribution

Hector's dolphin is endemic to inshore waters of the main islands of New Zealand. It is most common along the east and west coasts of South Island between 41° 30' and 44° 30'S, with hot spots of abundance at Banks Peninsula and between Karamea and Makawhio Point. An apparently isolated population exists in Te Wae Wae Bay, on the Southland coast (Dawson, 2002).

There is a very small population occurring on the west coast of the North Island between 36°30' and 38°20'S.

The species is rarely seen more than 8 km from shore or in water more than 75 m deep (Dawson, 2002).

3. Population size

Braeger and Schneider (1998) report that small to medium-sized groups of Hector's dolphins with 1-60 individuals were observed in almost all areas of the west coast of South Island in winter as well as in summer. Maximum densities peaked at 5-18 individuals per nautical mile of coastline between Cape Foulwind and Hokitika. Recent surveys suggest South Island populations number ca. 1,900 (east coast) and ca. 5,400 (west coast). The North Island west coast population may number fewer than 100 individuals (Dawson, 2002) and is vulnerable to extinction (Dawson et al. 2001).

4. Biology and Behaviour

Habitat: The most consistent factor influencing the distribution of Hector's dolphins appears to be their preference for shallow waters. This may explain their apparent absence from Fiordland, where depths in excess of 300 m are very common, and their apparent reluctance to cross Cook Strait to North Island waters. Hector's dolphins inhabit a wide range of water temperatures (surface temperature 6.3-22°C;) and water turbidity (<10 cm to >15 m) (Dawson and Slooten, 1994).

Behaviour: Rarely bow-rides, but frequently swims in the wake of passing boats; may also swim alongside boats for short distances. Unlike many dolphins, it prefers stationary or slow vessels (less than 10 knots) and will dive to avoid faster ones. Inquisitive (Carwardine, 1995). Mothers with newborn calves are shy, and seldom approach stationary or moving boats. Except in ports and other areas of very intensive boat traffic, it seems unlikely that the presence of boats will greatly affect the behaviour and distribution of this species (Slooten and Dawson, 1994, and refs. therein).

Schooling: The habits and biology of Hector's dolphin have been well studied only in the last few years. They live in groups of 2 to 8 individuals. Larger aggregations of up to 50 can be seen at times (Jefferson et al. 1993). Groups rarely stay in tight formation, though several individuals may swim and surface together in a row. Most active when small groups join together (Carwardine, 1995).

Reproduction: The calving season is in the spring through early summer (Jefferson et al. 1993).

Food: Hector's dolphins appear to feed mostly in small groups. The dolphins feed opportunistically, both at the bottom and throughout the water column, and take a wide variety of species. Surface-schooling fish (e.g. yellow-eyed mullet, *Aldrichetta forsteri*, kahawai, *Arripis trutta*) and arrow squid, *Nototadarus* sp., are taken along with benthic fishes such as ahuru, *Auchenoceros punctatus*, red cod, *Pseudophycis bacchus* and stargazer, *Crapatalus novaezelandiae*. Crustaceans are occasionally found among the stomach contents, including *Ovalipes catharus*, *Hymenosoma depressum* and *Macroptkalmus hirtipes*, but these appear to be from the stomach contents of fish taken by the Hector's dolphins. In summer, dolphins occasionally follow inshore trawlers, apparently stationing themselves behind the cod-end of the net. The dolphins themselves are rarely caught in trawl nets (Slooten and Dawson, 1994, and refs. therein).

5. Migration

Stone et al. (1998) observed Hector's dolphin movement patterns via radio-telemetry and found them to be remarkably consistent. Each dolphin remained in Akaroa Harbor for a period of between one and five hours, after which each swam out of the harbor in a westerly direction, always in the late afternoon or early evening. Two dolphins returned to Akaroa Harbor the next morning. The remaining animals either lost their tags overnight or did not return.

These patterns support previous studies which described a diurnal movement pattern for this species (Stone et al. 1995). Despite wide-ranging surveys over more than a decade, no two sightings of the same individual were ever more than 106 km apart (Dawson, 2002).

6. Threats

Direct catch: Not reported within the last years (Slooten and Dawson, 1994).

Incidental catch: The catch of large numbers of Hector's dolphins in coastal gillnets, many of them used by recreational fishermen, has been documented in recent years. Due to evidence that the catches were seriously threatening the estimated 3,000 to 4,000 Hector's dolphins around New Zealand, the N.Z. government created a marine mammal sanctuary in 1989 to protect them (Jefferson et al. 1993; Slooten and Dawson, 1994). However, Cameron et al. (1999) found no evidence that dolphin survival rates increased following establishment of the sanctuary. In 1997/98

18 Hector's dolphins were caught in gill nets to the north and south of the sanctuary (Dawson, 2002).

Strandings are exclusively of single animals and many beach-cast dolphins bear cuts and abrasions consistent with being caught and killed in gill nets (Slooten and Dawson, 1994). Stone et al. (1997) showed that Hector's dolphin distributions were affected by 10 kHz pingers and that dolphins avoided the immediate area where the pingers were active, but did not avoid the larger area of Akaroa Harbour. This suggests that pinger use could reduce mortality in gill nets.

Pollution: The strictly coastal distribution of this species makes it vulnerable to accumulation of pollutants such as heavy metals and pesticide residues. Although their precise biological effects are poorly known, the level of some of the contaminants gives some cause for concern. Moderate to high levels of DDT, PCBs and Dioxin have been found in the tissues of Hector's dolphins. These compounds are known to interfere with reproduction and their effects are worsened by synergism between compounds. Mercury, Cadmium and Copper levels are also relatively high when compared to other species. It is not known to what extent pesticide contamination or other forms of pollution contribute to mortality or to the low reproductive rates observed in Hector's dolphins (Slooten and Dawson, 1994).

Tourism: There has been a rapid growth in marine mammal-based tourism around the world, because marine mammals have a wide appeal for many people and are readily found around many coastal areas and are therefore readily accessible. Marine mammal-based tourism in New Zealand is a wide-ranging, species-diverse industry with an increasing demand for permits from land, boat and air-based platforms. A total of 74 permits at 26 sites have been issued from Maunganui to Stewart Island (Constantine, 1999).

Dolphins are not displaced by boats or by human swimmers. Swimmers cause only weak, non-significant effects, perhaps because dolphins can very easily avoid them. Reactions to dolphin-watching boats are stronger. Analyses of relative orientation indicate that dolphins tend to approach a vessel in the initial stages of an encounter but become less interested as the encounter progresses. By 70 min into an encounter dolphins are either actively avoiding the boat or equivocal towards it, approaching significantly less often than would be expected by chance. Analyses of group dispersion indicate that dolphins are significantly more tightly bunched when a boat was in the bay (Bejder et al. 1999).

7. Remarks

The endemic New Zealand Hector's dolphin is considered the rarest species of marine dolphin with a total abundance of less than 4,000. The South Island population is listed as "Endangered" (EN A1d, C1) by the IUCN based on (A) population reduction in the form of (1) an observed, estimated, inferred or suspected reduction of at least 80 % over the last 10 years or three generations, whichever is the longer, based on (and specifying) (d) actual or potential levels of exploitation. The North Island population is listed as "Critically Endangered" (CR C1, D) based on (C) Population estimated to number less than 250 mature individuals and (1) an estimated continuing decline of at least 25 % within three years or one generation, and (D) a population estimated to number less than 50 mature individuals.

Its vulnerability is further increased by its fidelity to local natal ranges and the genetic isolation of regional populations. Given its small size, reproductive isolation and reduced genetic diversity, the North Island population is likely to become extinct. Based on trend analysis of the mtDNA diversity, it has been suggested that the East Coast population will lose all mtDNA diversity within the next 20 years. This time-series of reduction in genetic variation provides independent evidence of the severity of population decline and habitat contraction resulting from fisheries and perhaps other human activities (Pichler and Baker, 2000). Martien et al. (1999) also found that two populations of Hector's dolphins are predicted to decline in the future even when the most optimistic parameter estimates for population prediction are used. The status of the third population depends on annual population growth rate.

New Zealand Hector's dolphin is not included in Appendix II of the CMS because it is endemic to New Zealand.

Research efforts should be concentrated on estimates of entanglement mortality rates and maximum population growth rate. Fishing with nets should be prohibited in areas of high dolphin concentrations and marine sanctuaries should be completely protected, closing loopholes for recreational fishermen. Also, the use of mitigating measures such as acoustic net-deterrents should be enforced.

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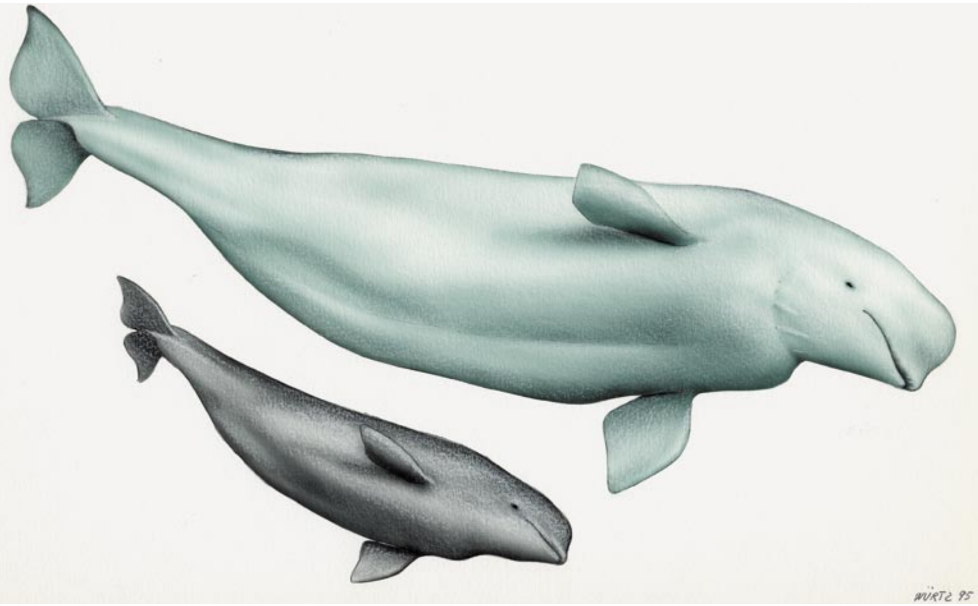
5.7 Delphinapterus leucas (Pallas, 1776)

English: white whale; beluga
German: Weißwal; Beluga
Spanish: beluga; ballena blanca
French: belouga, dauphin blanc; marsouin blanc

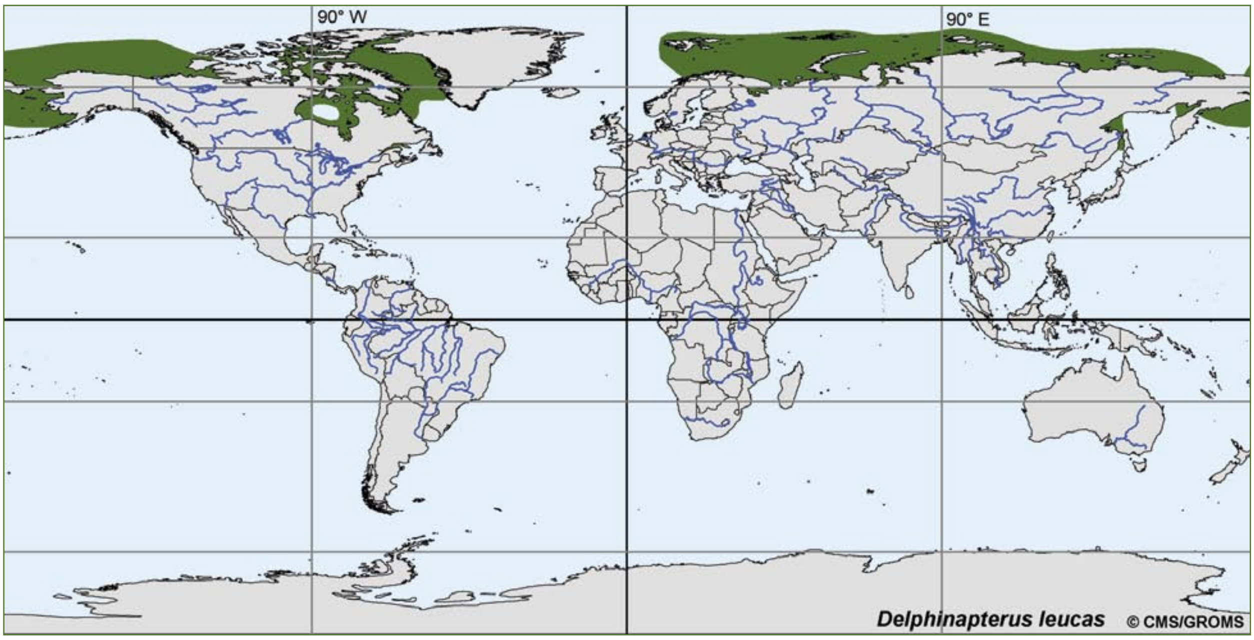


Drawing of Delphinapterus leucas © Wurtz-Artescienza.

1. Description

The beluga is a medium-sized odontocete, 3.5-5.5 m long and reaches a mass of up to 1,500 kg. Males are more robust and 25 % longer than females. White whales lack a dorsal fin and, unlike other cetaceans, have unfused cervical vertebrae, allowing lateral flexibility of the head and neck.

Young are about 1.6 m long and are born a grey-cream colour, which then turns to dark brown or blue-grey. The distinctive pure white colour of beluga whales is reached in 7 year old females and 9 year old males (O'Corry Crowe, 2002).



Beluga distribution (mod. from O'Corry-Crowe, 2002; © CMS/GROMS): the northernmost extent of its known distribution is off Alaska and northwest Canada and off Ellesmere Island, West Greenland, and Svalbard (above 80°N). The southern limit is in the St. Lawrence river in eastern Canada (47°-49° N).

2. Distribution

Beluga whales are widely distributed around the Arctic Ocean and adjacent seas, and occur mainly in shallow shelf waters. Their range covers Hudson and James Bay; Somerset Island, Devon Island, the east coast of Baffin Island, and Ungava Bay; the northwest coast of Greenland from Inglefield Bredning south to Julianehab; the vicinity of Scoresby Sund on the East-central coast of Greenland; the Arctic coast of western and central Eurasia, from the Barents and White seas east to the Laptev sea, including Svalbard, Zemlya Frantsa Iosifa, Novaya Zemlya, Severnaya Zemlya, and Novosibirskiye Ostrova; the Arctic coast of eastern Siberia from Ostrov Vrangelya to Bering Strait; the Bering Sea south to Anadyrskiy Zaliv and Bristol Bay; the Arctic coast of Alaska and Northwestern Canada from the Chukchi Sea and Kotzebue Sound east to the Beaufort sea. Vagrants were observed off New Jersey, Iceland, the Faroes, Ireland, Scotland, the Atlantic coast of France, the Netherlands, Denmark, Japan and Washington State (Rice, 1998).

The fact that beluga whales
- from different areas differ in body size,
- have a non-uniform distribution pattern,
- return to predictable, specific coastal areas,
- from different areas show differences in contaminant signatures,
- exhibit a geographic variation in vocal repertoire,

has led to the identification of a number of independent stocks (O'Corry Crowe, 2002).

According to Rice (1998), there are five widely disjunct populations a) in the Saint Lawrence estuary, b) in the northern and c) western sea of Okhotsk including Tatarskyi Zaliv, d) in Cook Inlet and e) in the Northern Gulf of Alaska.

In particular, beluga from western North America (Bering Sea) can be clearly distinguished from beluga from eastern North America (Hudson Strait, Baffin Bay, and St. Lawrence River). Based upon a combined data set (mitochondrial and nuclear DNA), Gladden et al. (1999) divided the population of North American beluga whales into two evolutionarily significant units.

However, according to O' Corry-Crowe et al. (1997) the patterns of mitochondrial DNA variation in beluga whales indicate that the summering concentrations are demographically, if not phyletically distinct. They inferred the recent evolutionary history, population structure and movement patterns of beluga whales in the western Nearctic from an mtDNA analysis of control region sequence variation of 324 whales from 32 locations representing five summer concentration areas in Alaska and north-west Canada. Population structure appears to be maintained primarily by natal homing behaviour, while asymmetries in dispersal may be associated with the type of mating system. Maiers et al. (1996) examined 5 amplified alleles which revealed significant allele frequency differences among beluga from Alaska, Mackenzie Delta, Nastapoka River, and St. Lawrence River.

3. Population size

The beluga population is subdivided into management units to reflect distinct groups of beluga at summering locations. In its 2000 report, the IWC recognises 29 putative stocks for 1) Cook Inlet, 2) Bristol Bay, 3) E. Bering Sea, 4) E. Chukchi Sea, 5) Beaufort Sea, 6) North Water, 7) W. Greenland, 8) Cumberland Sound, 9) Frobisher Bay, 10) Ungava Bay, 11) Foxe Basin, 12) W. Hudson Bay, 13) S. Hudson Bay, 14) James Bay, 15) E. Hudson Bay, 16) St. Lawrence, 17) Svalbard, 18) Franz Josef Land, 19) Ob Gulf, 20) Yenesy Gulf, 21) Onezhsky Bay, 22) Mezhenskyi Bay, 23) Dvinskyi Bay, 24) Laptev Sea, 25) W. Chukchi - E. Siberian Seas, 26) Anadyr Gulf, 27) Shelikov Bay, 28) Sakhalin-Amur, and 29) Shantar. Stock boundaries sometimes overlap spatially and in such cases the geographical delineation of white whale stocks must have a temporal component (IWC, 2000).

Alaska (IWC, 2000):		
1.	Cook Inlet	347
2.	Bristol Bay	1,100
3.	East Bering Sea	12,675
4.	E Chuckchi Sea	3,700
5.	Beaufort Sea	39,257

Limited data suggest that numbers in Bristol Bay, the North Sound/Yukon River delta region, and the eastern Chukchi Sea (including Kotzebue Sound and the Kasegaluk Lagoon region) have generally stayed stable over the past 20-30 yrs., although substantial fluctuations in local distribution have occurred in the Kotzebue Sound region (Frost and Lowry 1990). Frost et al. (1993) conducted aerial surveys in the north-eastern Chukchi Sea during 1989-91 to investigate the distribution and abundance of beluga whales. Comparisons with data from previous years suggest that the numbers of belugas using the area have been relatively stable since the late 1970s.

Harwood et al. (1996) report that the population of the Southeast Beaufort Sea, Mackenzie Estuary, and West Amundsen Gulf monitored over a 55-h period on 23-25 July 1992 yielded an index of stock size of 19,629 visible beluga; this does not account for those far below the surface and therefore unavailable to the observers, or those outside the area.

Canada and West Greenland (IWC, 2000):		
6.	North Water (Baffin Bay)	28,000
7.	West Greenland	2,000
8.	Cumberland Sound	485
9.	Frobisher Bay	no info
10.	Ungava Bay	< 50
11.	West Hudson Nay	25,100
12.	Foxe Basin	1,000
13.	South Hudson Bay	1,299
14.	James Bay	3,300
15.	East Hudson Bay	1,014
16.	St Lawrence River	1,238

Heide-Jørgensen and Reeves (1996) conducted aerial surveys of belugas off West Greenland in March 1993 and 1994. These surveys were designed to permit comparisons with similar surveys in 1981, 1982, and 1991. Although the 1990s surveys were, if anything, more efficient than the 1980s surveys, strip-census estimates showed a 62% decline from 1981 to 1994. There is reason for concern about this strong decline (see below).

According to Richard et al. (1990), the western Hudson Bay population is estimated to number in excess of 23,000 individuals and more than 1,300 belugas were seen along the southern Hudson Bay coast. Northern Hudson Bay has a population estimated at more than 700 animals, while fewer than 500 were found in south-east Baffin Island. Aerial surveys document a continuous July distribution of belugas along the coast of Hudson Bay from Eskimo Point, N.W.T., to James Bay and the occurrence of a small July population in northern Hudson Bay, and confirm that few belugas occupy the south-east Baffin Island coast in August, outside of Cumberland Sound.

Lesage and Kingsley (1998) consider that the St. Lawrence population can conservatively be indexed at between 600 and 700 and is slowly increasing. Reproductive rates, survival rates at each age, and population age structure are similar to those of other beluga populations.

Former Soviet Union (Bjoerge et al. 1991; IWC, 2000):		
17.	Svalbard	300-3,000
18-24.	W. Siberia (Barents - Laptev Sea)	500-1,000
25.	East Siberia (W Chukchi - E Siberian Sea)	2,000-3,000
26.	Anadyr Delta	200-3,000
27-29.	Sea of Okhotsk	18,000-20,000

The data for the former Soviet Union differ somewhat from the population estimates given in Reyes, 1991. According to the IWC (2000) report, stock 17 (Svalbard) numbers in the few hundreds to low thousands, stocks 18 - 23 number in the low hundreds, whereas there is no information on stock 24.

4. Biology and Behaviour

Habitat: White whales seem to prefer shallow coastal waters and river mouths, although they may migrate through deep waters. In some areas these cetaceans are reported to spend most of their time in offshore waters, where feeding and calving may take place (Reyes, 1991 and refs. therein).

Frost et al. (1993) conducted aerial surveys in the north-eastern Chukchi Sea. The presence of near-shore gravel beds and warm, low-salinity water probably combine to make this region important as a place for belugas to moult. They suggest that activities associated with oil, gas, coal, and mineral resource development should be regulated to minimise their potential impacts on important beluga habitats.

Barber et al. (2001) examined the spatial and temporal relationships between belugas and two characteristics of their habitat, bathymetry and ice concentra-tion. Their results show that beluga distribution is bimodal with respect to bathymetry, with a larger mode in shallow water and a smaller mode in water approximately 500 m deep. They occur more often than expected by chance in the 0/10 ice class and less often than expected in the 10/10 ice class. Males and females associate differently with both depth and ice concentration. Females associate with bathymetry very differently in the fall than in the summer. There is a general tendency for males in the eastern North American Arctic to be associated with shallow water during the summer and deeper water (modes at 100 and 500 m) in the fall. Female locations are associated more often with the 0/10 ice class and less often with the 10/10 class than expected by chance. These trends were stronger in the western than in the eastern portions of the Canadian Arctic (Barber et al. 2001).

Food: Feeding habits vary, depending on the geographical location and the season. Belugas dive regularly to the sea floor at depths of 300-600 m. In the deep waters beyond the continental shelf, belugas may dive in excess of 1,000 m and may remain submerged for more than 25 min (Richard et al. 1997, Martin et al. 1998). In western Hudson Bay they feed on capelin (*Mallotus villosus*), river fish such as cisco (*Leucichthys artedi*) and pike (*Esox lucius*), marine worms and squids. Further north, belugas rely on crustaceans, arctic char (*Salvelinus alpinus*), Greenland cod (*Gadus ogac*), and arctic cod (*Boreogadus saida*). In the St.-Lawrence, capelin, sand lance (*Anunodytes americanus*), marine worms and squid are eaten, while in Alaskan waters the species feed on fish, mainly salmon. Evidence for offshore feeding comes from finding offshore squid (*Gonatus fabricii*) in the stomach of whales in the Beaufort Sea (Reyes, 1991 and refs. therein).

Schooling: Beluga whales are highly gregarious. They are found in groups of up to about 15 individuals, but aggregations of several thousand can be observed at times. Pods are often segregated by age and sex (Jefferson et al. 1993).

Reproduction: Calves are born in spring to summer, between April and August, depending on the population (Jefferson et al. 1993).

5. Migration

General patterns: Not all white whales are migratory. Some populations are resident in well-defined areas, for example in Cook Inlet, the St. Lawrence estuary and possibly in Cumberland Sound, while others are strongly migratory. In the latter case the migration shows a seasonal pattern. The whales arrive in coastal waters and river estuaries during midsummer. In the winter, they move to offshore waters, staying at the edge of the pack ice or in polynyas. It is thought that the migration may be a response to the dynamics of the pack ice, food availability and the search of areas suitable for calving or early growth of the young (Reyes, 1991). Although these migrations occur regularly, routes and dates are poorly known. Wintering grounds lie mostly in the north near the pack ice. Calving occurs predominantly in warm riverine estuaries in the south (Gewalt, 1994).

The basic migratory schedule of belugas is quite consistent and seems to be governed primarily by photoperiod rather than by other physical or biological factors, including sea-ice conditions (Heide-Jørgensen and Reeves, 1996). They migrate rapidly away from the summering grounds in the Canadian High Arctic in early September as day length shortens. Migrating whales from different stocks may approach and move past a given site in 'waves', while a summer 'resident' stock moves into that same area for an extended period. For example, the Eastern Chukchi Sea stock is temporally delineated as the group of whales that arrives in Kotzebue Sound or Kasegaluk Lagoon as the ice begins to break up and remains there for at least several weeks. Earlier in the year, whales from the Beaufort Sea stock move through this area in the spring lead system. Thus, the annual catch at villages such as Point Hope, Kivalina and Barrow can consist of whales from both of these stocks (IWC, 2000).

In summer, belugas ascend rivers: the Severnaya Dvina, Mezen', Pechora, Ob' Yenisey in Asia, the Yukon and Kuskokwim rivers in Alaska and the St. Lawrence River in eastern Canada (Rice, 1998). A study by Aubin (1989) demonstrated that occupation of river estuaries is an important metabolic stimulus to belugas, and facilitates epidermal renewal in a manner analogous to a moult. There are a few records of solitary individuals ranging thousands of kilometres up various rivers (c.f. Gewalt, 1994).

White whales from the Bering sea move north along the west coast of Alaska and the east coast of the former Soviet Union from April through early summer. These whales are said to spend the winter in the central and south-western Bering sea along the former soviet coast. There are indications that populations from western Hudson Bay, eastern Hudson Bay and Ungava Bay overwinter together in the pack ice in Hudson Strait. In spring the whales from each population separate and migrate to their distinct summering grounds. Populations from the White, Kara and Laptev Seas overwinter in the Barents Sea (Reyes, 1991 and refs. therein).

Smith and Martin (1994) reported the first arrival of belugas at Cunningham Inlet during mid-July and their departure in early August. The timing of beluga arrival in West Greenland is in late September and early October. The spring northward migration in Baffin Bay coincides with the dramatic increase in daylight (Heide-Jørgensen and Reeves, 1996).

Recent genetic studies of white whales have primarily involved analyses of mitochondrial or nuclear DNA. The mtDNA analyses suggest that there is limited movement between major summering grounds and therefore that colonisation of depleted areas by whales from other summer concentrations would be slow. It was also noted, however, that recent satellite tracking data show white whales to be less ice-limited than previously thought; they travel long distances into the permanent polar ice during the summer. Thus, ideas about the physical barriers to movement and hypotheses concerning the convergence of several summering stocks on a single wintering ground may need to be reconsidered (IWC, 2000).

Detailed accounts: Several studies involving satellite-transmitters were conducted in recent years. The following accounts are sorted from east to west, beginning in the Bering and Chukchi Seas.

Richard et al. (2001a) tagged and tracked Beluga whales of the eastern Beaufort Sea stock with satellite-linked time-depth recorders during summer and autumn in 1993, 1995, and 1997. Whales occupied the Mackenzie estuary intermittently and for only a few days at a time. They spent much of their time off-shore, near or beyond the shelf break and in the polar pack ice of the estuary, or in Amundsen Gulf, Mc'Clure Strait, and Viscount Melville Sound. The movements of tagged belugas into the polar pack and into passages of the Canadian Arctic Archipelago suggest that aerial surveys conducted in the southeastern Beaufort Sea and Amundsen Gulf may have substantially underestimated the size of the eastern Beaufort Sea stock. Ranges of male and female belugas were somewhat segregated in two of the three years of study. In late July of 1993 and 1995, most males were located in Viscount Melville Sound, while females were primarily in Amundsen Gulf. Movement patterns of males tagged in late July in 1997 were different from those of males tagged in early July in 1993 and 1995. In September, belugas migrated westward along the continental shelf and farther offshore in the Alaskan Beaufort Sea. The tracks from 1997 show that the western Chukchi Sea is an autumn migratory destination and that at least some belugas continued their migration south towards the Bering Strait in November. Some conclusions from this study about beluga ecology challenge conventional wisdom, in that estuarine occupation appears to be short-lived, belugas travel long distances in summer to areas hundreds of kilometres from the Mackenzie Delta, and they do not avoid dense pack ice in summer and autumn (Richard et al. 2001b).

Suydam et al (2001) live-captured five belugas in Kasegaluk Lagoon, eastern Chukchi Sea and attached satellite-linked depth recorders to them. The belugas, caught between 26 June and 1 July 1998, were all males, ranging in length from 398 to 440 cm. A 310 cm gray beluga accompanied the smallest male. Two tags transmitted for only about two weeks, during which time one animal remained in the vicinity of Icy Cape, 80 km north of the capture site, and the other traveled to Point Barrow, about 300 km north. The other three tags operated for 60-104 days, and those belugas traveled more than 2,000 km, reaching 80°N and 133°W, almost 1,100 km north of the Alaska coast. This journey required them to move through 700 km of more than 90 % ice cover. Two of the whal-es then moved southward into the Beaufort Sea north and east of Point Barrow. Two whales later moved to an area north of the Mackenzie River delta, where they spent 2-3 weeks before once again heading southwest towards Barrow (Suydam et al. 2001).

Richard et al. (1998) instrumented six adult belugas (2-males, 4 females) with satellite-linked transmitters in Croker Bay, south-eastern Devon Island in the Canadian High Arctic in mid-September 1995. Some days, the animals remained close to shore along the south-eastern and eastern shoreline of Devon Island, presumably foraging for arctic cod (*Boreogadus saida*) and other prey. They spent the rest of the time in the deep waters of Lady Ann Strait, eastern Jones Sound, and the waters south-east of Coburg Island, presumably feeding on deep water prey. Only males went farther north in waters off south-eastern Ellesmere Island. The belugas' swimming speeds decreased in the later part of the study period. Their last transmissions came from the North Water, an area where belugas are known to winter. Results of this study were unfortunately not sufficient to determine the extent of movement of belugas between the eastern Canadian Arctic and Greenland.

Richard et al. (2001a) live-captured and instrumented 21 adult belugas (8M, 13F) with satellite-linked transmitters in the summer and fall of 1996 on the Canadian north-east coast: Twelve were captured in estuaries along the coast of Somerset Island in July and nine were captured in September in Croker Bay, SE Devon Island. Most of the animals moved rapidly to southern Peel Sound, where they all spent the month of August, making frequent deep dives, some of which were to depths near or at the seabed of the Franklin Trench. The belugas also used several bays along the coast of Prince of Wales Island and another one on Melville Peninsula. They left southern Peel Sound between late August and early September and moved rapidly to the south coast of Devon Island, many using Maxwell Bay and Croker Bay for several days. All belugas instrumented in Croker Bay in September, as well as the summer-tagged individuals that were still transmitting, moved east and north along the south and east coasts of Devon Island, eventually reaching Jones Sound and north Baffin Bay. They used many bays along the east coast of Devon Island and dove to depths often exceeding 200 m in the surrounding waters. Fifteen of the tags continued to transmit during the period when belugas are normally observed migrating along the West Greenland coast (late September-early October). However, only one of the tagged animals moved to Greenland waters in late September. The others remained in the area known in winter as the North Water. The autumn tracking results suggest that the North Water may harbour a larger winter population of belugas than was previously suspected (Richard et al. 2001a).

Kingsley et al. (2001) fitted 3 adult and 3 juvenile belugas with satellite-linked depth recorders in eastern Hudson Bay in mid-August 1993, and one adult was tagged in mid-October 1995 in extreme northeastern Hudson Bay. The belugas tagged in summer in eastern Hudson Bay made no directed or long-distance movements while the tags were attached. Their range did not include the Belcher Islands, and belugas observed in aerial surveys of those islands do not appear to belong to the eastern coastal stock. The single beluga tagged in northern Quebec in October moved into the deep water of western Hudson Strait and travelled east along the southern coast of Hudson Strait, slowing up on reaching shallower water off Salluit and near Charles Island. This whale was still off Salluit when the tag stopped transmitting. All belugas, even the one that was in deep water in Hudson Strait, showed dive depth characteristics that were consistent with diving usually to the bottom. However, all belugas always—even in deep water—made dives that usually lasted less than 10 min and very seldom lasted more than 12-min. Belugas tagged as pairs of adults and young showed striking correlations of dive behaviour. The data obtained indicate that it would be appropriate to correct aerial surveys by adding 85% to aerial counts (Kingsley et al. 2001).

Lydersen et al (2001) fitted 15 adult white whales with satellite relay data loggers (SRDLs) in order to study their distribution and movement patterns in Svalbard. A total of 844 d of tracking data was recorded. The average longevity of the SRDLs was 56 d. The tracking data were analysed using a computer visualisation system, which allowed the movement patterns to be animated against a background map of the study area. This enabled classification of the whales' tracking data into 4 major activity patterns: (1) glacier front stationary (55.6% of the time), (2) in-fjord movements (10.6% of the time), (3) coastal movements (26.0% of the time), and (4) coastal stationary (7.8% of the time). The whales spent most of their time relatively stationary, close to different glacier fronts in the area. These areas are known to have a high abundance of potential prey species for white whales, so foraging is the probable reason for this behaviour. When the whales changed location, they did so in an apparently directed and rapid manner. Average horizontal swimming speed was at least 6 km/h during long-distance movements. Movements between glacier fronts were extremely coastal in nature and took place in shallow waters. This behaviour has probably developed as a means of avoiding predators (Lydersen et al. 2001). Kovacs (pers. comm.) found that none of these tagged animals left Norwegian waters. If they are "linked" to any population it is likely with Russia.

As opposed to these high-tech approaches, traditional ecological knowledge (TEK) has been used opportunistically in biological studies of beluga whales in Alaska (Huntington, 1999). The first effort to document this knowledge systematically, which took place in Norton Bay, Buckland, and Point Lay, Alaska, provided descriptions of migratory and local movements, feeding, calving, ecological interactions, and human influences on distribution and behaviour. The results are consistent with those of previous studies but add considerable detail, including descriptions of avoidance and habituation responses to anthropogenic noise, which appear to depend in part on association with hunting activities.

Similarly, the first systematic effort to document TEK of beluga whales in Russia was conducted by Mymrin and Huntington (1999) in the villages of Sireniki, Novoe Chaplino, Yanrakinnot, and Uelen, in the Chukotka Autonomous Okrug. Their findings describe migratory and local movements, feeding, calving, ecological interactions, and human influences on distribution and behaviour. The results add considerable detail to published accounts of belugas in Russian waters of the Bering and Chukchi Seas. Among these are descriptions of avoidance and habituation responses to anthropogenic noise, which appear to depend in part on association with hunting activities. Authors observe that most of the TEK documented in this study came from older hunters, and that the collective pool of traditional knowledge in the region is disappearing.

The detailed accounts from the final report of Huntington and Mymrin (1996) on "Traditional Ecological Knowledge of Beluga Whales: An Indigenous Knowledge Pilot Project in the Chukchi and Northern Bering Seas" can be viewed in the internet on the pages of the Arctic Studies Center.

6. Threats

Direct catches: A permit for a catch quota of 1,000 Beluga whales has been issued by the Russian Commission for Fisheries in 2002. The Small Cetaceans Subcommittee of IWC expressed concern over such takes of small cetaceans when there was insufficient information to adequately assess the impact, and recommended an assessment of the size of the affected populations and the impacts of the removals (W. Perrin, pers. comm.).

Whereas direct takes are mostly from aboriginal hunting, indirect takes are primarily from incidental catch in fishery operations. The most immediate concerns relate to continuing harvests from small and depleted populations (IWC, 2000). According to Heide-Jørgensen (1994) for instance, "Surveys to estimate the relative abundance of belugas indicate a dramatic decline in West Greenland since 1981. Surveys to estimate the total abundance are either incomplete, have wide confidence limits or are too old to be used to adjust present catches to sustainable levels". For fur-ther details, see "remarks" below.

Global warming: As recent decreases in ice coverage have been more extensive in the Siberian Arctic (60° E-180° E) than in the Beaufort Sea and western sectors, Tynan and De Master (1997) speculate that marine mammals in the Siberian Arctic may be among the first to experience climate-induced geographic shifts or altered reproductive capacity due to persistent changes in ice extent. Alteration in the extent and productivity of ice-edge systems may affect the density and distribution of important ice-associated prey of marine mammals, such as arctic cod (*Boreogadus saida*) and sympagic ("with ice") amphipods. Changes in sea ice extent and concentration thus have the potential to alter the distribution, range and migration patterns of cetaceans associated with ice habitats, and thus indirectly affect nutritional status, reproductive success, and ultimately the abundance and stock structure of these species (Tynan and DeMaster, 1997).

Changes in cetacean habitat and distribution of prey species are expected to be more significant for ice edge feeders than more wide ranging oceanic species (Everett and Bolton, 1996). The IWC has noted the vulnerability of Arctic bowhead (*Balaena mysticetus*), beluga (*Delphinapterus leucas*) and narwhal (*Monodon monoceros*) to changes in ice conditions (IWC, 1997).

The pivotal species in the high Arctic food web is the Arctic cod (*Boreogadus saida*) (Ainley and DeMaster, 1990), although the ecosystem is, in fact, fairly complex. The timing of the phytoplankton bloom, driven by the break up and melting of ice, is critical to the immediate success of first-feeding larvae of Arctic cod (Tynan and DeMaster, 1997). Alteration in the extent, timing and productivity of ice-edge systems may therefore affect the density and distribution of Arctic cod, and in turn the foraging success and nutritional condition of dependent species such as beluga and narwhal.

A detailed Overview of Global Environmental Change and its Potential Impact on Cetaceans can be found at www.worldwildlife.org/news/pubs/wwf_ocean.htm

Belugas of the St. Lawrence Estuary: A small geographically isolated sub-Arctic population of belugas reside year-round in a short segment of the St. Lawrence river estuary. For more than 50 years the belugas have been exposed to industrial pollutants including organochlorines, polycyclic aromatic hydrocarbons (PAH), and heavy metals. Studies have found that concentrations of both total PCBs and highly chlorinated PCB congeners are much higher in St. Lawrence belugas than Arctic belugas. Scientists believe that the increased occurrence of opportunistic bacterial infections, parasitic infestation, gastric ulcers and other disorders in St. Lawrence beluga whales is evidence of a link between immune system dysfunction and PCB exposure (Martineau et al. 1994).

Although rare in free-ranging mammals, and particularly in wild cetaceans, neoplasms (tumours) are regularly diagnosed in St. Lawrence belugas (Martineau et al. 1998; Lair et al. 1998). The prevalence of adenocarcinomas of the gastrointestinal tract is particularly high, constituting half of the malignant tumours found in the population (Martineau et al. 1998). The high rate of cancer seen in beluga whales has been attributed to PAH contaminants such as benzopyrene (BP), a prototypical and well-studied chemical carcinogen (Martineau et al. 1994).

It has been speculated that the feeding strategy of beluga whales makes them particularly susceptible to digestive tract cancers (Martineau et al. 1998). Belugas feed significantly on bottom invertebrates, and have been observed partially covered by mud when surfacing, suggesting that they dig into sediments (Dalcourt et al. 1992). Thus it is likely that St. Lawrence beluga directly ingest carcinogenic compounds. These findings are important when considering environmental threats to belugas in other geographical areas as well.

Ambient noise: Movements of belugas through the mouth of the Saguenay river have been monitored by several researchers during the last decade. After selecting comparable data from each research group, Caron and Sergeant (1988) noted a decline in beluga passage rate of more than 60% over this period (from 3.9 belugas/hour to 1.3 belugas/hour in the later years). The decline occurred over a relatively short period, between 1982 and 1986, which coincided with an increase in recreational boat activities in the area. Without excluding other influencing factors inside or outside the Saguenay area, a link between boat traffic and beluga passage was hypothesized.

In 1986, Cosens and Dueck (1993) recorded noise emitted by the icebreakers MV Arctic, CCGS des Groseilliers and MV Lady Franklin during routine icebreaking operations and travel to and from the mine at Nanisivik, Baffin Island, Northwest Territories, Canada. They found that MV Arctic generated more high frequency noise than did the other vessels recorded. Monitoring of vessel noise levels indicated that belugas and, probably, narwhals (*Monodon monoceros*) should be able to detect the high frequency components of MV Arctic noise at least as far as 25 to 30 km from the source. The ability of whales to detect the MV Arctic at long distances may explain why belugas and narwhals in Lancaster Sound seem to react to ships at longer distances than do other stocks of arctic whales.

The responses of belugas to ice-breaking ships in the Canadian High Arctic were also studied over a 3-yr period by Finley et al. (1990). Typically, belugas moved rapidly along ice edges away from approaching ships and showed strong avoidance reactions to ships aproaching at distances of 35-50 km when noise levels ranged from 94-105 dB re 1 µPa in the 20-1000 Hz band. The "flee" response of the beluga involved large herds undertaking long dives close to or beneath the ice edge; pod integrity broke down and diving appeared asynchronous. Belugas were displaced along ice-edges by as much as 80 km. The responses of this species at unprecedented ranges may be explained in part by the fact that no similar field studies have been conducted in pristine marine environments with industrially-naive populations of marine mammals.

Habitat degradation: Current known or potential threats further include a wide variety of human activities: oil and gas development, over-harvesting, fisheries, vessel traffic (recreational, commercial and military), hydroelectric development in Hudson Bay, industrial and urban pollution and climate change. Reyes (1991 and references therein) summarised that hydroelectric development is one of the most important effect of human activities on white whales, which rely on warmer waters in estuaries and rivers for calving and early growth of young. Areas such as the McKenzie Delta and others are subject to oil exploration, which implies seismic ship surveys, offshore drilling or artificial island construction. These activities are undertaken in the summer months in the same areas occupied by belugas at this time of year.

7. Remarks

Lamson and Van der Zwaag suggested as early as 1987 that living resources, such as bowhead and beluga whales, undertake extensive transboundary migrations, one of the major factors which bid the United States and Canada to move toward more formalised arrangements for co-operative ocean management in the Arctic. Other countries, whose national territories may be used by the same beluga stocks include USA and Russia, Canada, Greenland, Norway (Svalbard) and Russia.

Heide-Jørgensen and Reeves (1996) summarise that while annual variability in ice conditions and other unknown factors may have had some local or small-scale effects on the movements and distribution of belugas off West Greenland, it is unlikely that these effects would account for the apparent decline in relative abundance. The most likely explanation of the decline is that the annual removals from the population by hunting, particularly in West Greenland, have exceeded the replacement yield. A revision of current management practice would be the consequence.

Range states are Canada, Denmark (Greenland), France (St. Pierre and Miquelon) Norway (Svalbard) the United States and Russia (Reyes, 1991) and the species is listed in appendix II of CMS.

Delphinapterus leucas is categorized as "vulnerable" (VU A1 abd) by the IUCN due to a population reduction in the form of an observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) a) direct observation; b) an index of abundance appropriate for the taxon; and d) actual or potential levels of exploitation (see "selected web-sites").

In its recent report (IWC, 2000) the IWC expressed concerns about the conservation status of a number of stocks because of their:

(1) depleted status relative to historical abundance (Cook Inlet, West Greenland, Ungava Bay, Cumberland Sound, East Hudson Bay, St Lawrence River);

(2) likely depleted status relative to historical abundance (Svalbard, Ob Gulf, Yenesy Gulf, Onezhsky Bay, Dvinsky Bay, Mezhensky Bay, Shelikov Bay, Shantar Bay, Sakhalin-Amur);

(3) current small population size or reduced range (Cook Inlet, Ungava Bay, Cumberland Sound, West Greenland, Ob Gulf, Yenesy Gulf); or

(4) recent decline (Cook Inlet, West. Greenland).

In the majority of stocks, the International Whaling Commission recommends that surveys be continued to determine current abundance and assess trends. Considering the wealth of information on movement patterns and habitat use gathered from satellite telemetry studies, it was recommended that such studies be continued and expanded. Recent genetic and contaminant analyses have resolved stock discreteness in some areas. However, more research is required to resolve microgeographic structure and seasonal movement patterns within some of these areas. In other regions no research of any kind has been conducted to determine stock boundaries. There is very little evidence, other than summer distribution, that supports the stock delineations of many of the Russian stocks proposed in the map. The IWC recommends that studies, including genetics, be undertaken to resolve the stock structure of white whales in Russian waters. Considering the potential impacts of industrial pollution on white whales in some areas of the Russian Arctic, samples should be collected for contaminant analysis and health assessment. Such a sampling programme could assist in stock identity as well as health assessment studies (IWC, 2000).

As a priority,

(1) The Committee recommends that stocks that are either depleted, small in size, or currently declining in numbers or range be considered as of highest conservation concern. Efforts to improve their current status should be undertaken and supported. Particular emphasis should be placed on those stocks where all three characteristics apply, e.g. Cook Inlet, Ungava Bay, West Greenland and East Hudson Bay. It is important to document catch localities and stock affinities of whales taken by settlements in Ungava Bay and Hudson Strait in order to evaluate the implications for the Ungava Bay and East Hudson Bay stocks.

(2) The Committee recommends that genetic and contaminant studies continue in order to further resolve questions about local structuring and movement patterns, and that sampling programmes be initiated in other areas, Russia in particular, to resolve questions of stock structure.

(3) The Committee recommends that sampling programmes to assess the health status of white whales continue throughout Alaska, Canada and Greenland, and that such programmes be initiated in Russia. Of particular concern are areas of high anthropogenic influence, including the south-east Barents Sea, which is the probable wintering ground for many of the Russian stocks (e.g. the Ob Gulf, Yenesy Gulf) and the Sakhalin-Amur region in the Okhotsk Sea.

(4) The Committee noted that tagging and telemetry studies of white whales have provided important new information relevant to stock identity, migrations, habitat use and abundance. It recommends that such studies are continued to increase sample size and are expanded to other regions.

(5) The Committee recommends that surveys of white whale distribution and abundance continue, particularly in areas where there is little recent information on either.

(6) The Committee recommends further research on age estimation, including the examination of teeth from known-age captive-born white whales, and encourages greater co-operation among relevant institutions and scientists to resolve this important issue (IWC, 2000).

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5.8 Delphinus capensis (Gray, 1828)

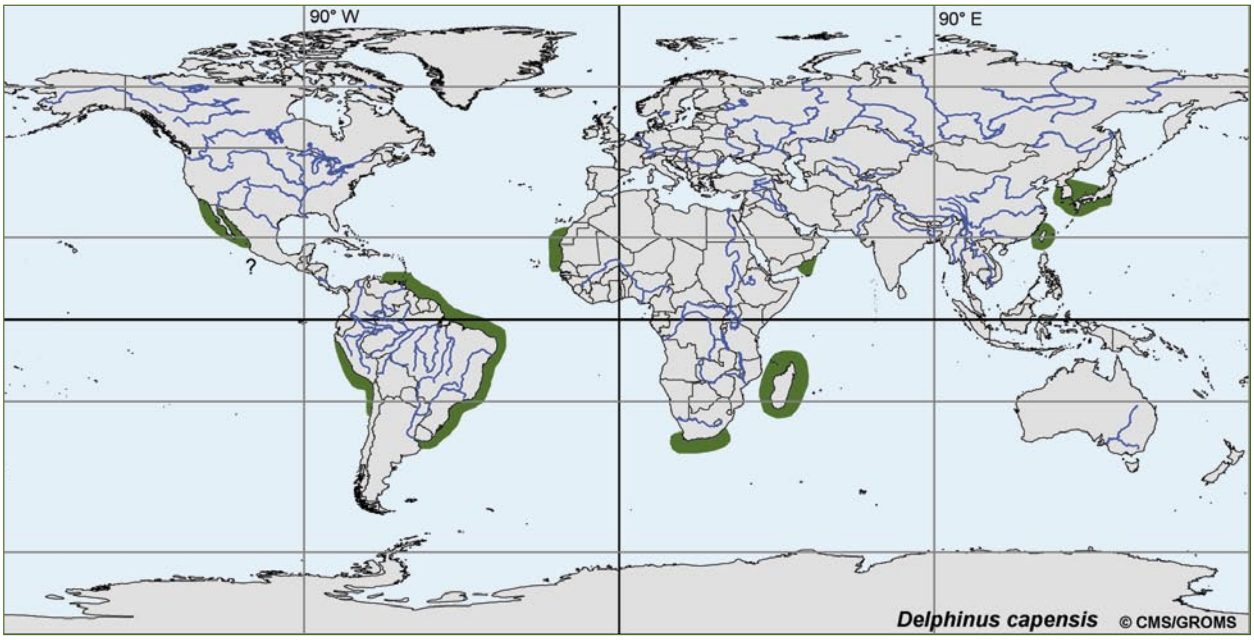
English: Longbeaked common dolphin
German: Gewöhnlicher Delphin mit langem Schnabel
Spanish: Delfín común a pico largo
French: Dauphin commun a bec large

Drawing of Delphinus capensis © Wurtz-Artescienza.

1. Description

All common dolphins are slender and have a long beak sharply demarcated from the melon. The dorsal fin is high and moderately curved backwards. Common dolphins are distinguished from other species by a unique crisscross colour pattern formed by interaction of the dorsal overlay and cape. This yields a four-part pattern of dark grey to black dorsally, buff to pale yellow anterior thoracic patch, light to medium grey on the flank and a white abdominal field. In the long-beaked species, the colour pattern is less crisp and colourful than in *D. delphis* (Perrin, 2002).

The taxonomy of the Common Dolphin is very complicated, as there are many variations. Research in



Distribution of Delphinus capensis: disjunct populations in warm temperate and tropical coastal waters (mod. from Perrin, 2002; © CMS/GROMS).

California and Mexico has revealed 2 distinct forms: the long-beaked and the short-beaked (Heyning and Perrin, 1994). These show many subtle physical and behavioural differences and recent evidence, based on morphological and genetic studies, suggests that they may be separate species. From limited observations elsewhere, these forms also appear to be distinguishable in other parts of the world.

2. Distribution

Disjunct populations of *D. capensis* are found in warm temperate and tropical coastal waters around the world. The overall distribution remains imperfectly known because of past confusion with *D. delphis*, but specimens have been identified from the following regions: coast of eastern South America from Venezuela to northern Argentina; west Africa from Western Sahara to Gabon; coast of South Africa from western Cape Province to Natal; coastal waters around Madagascar; the Jaza'ir al Hallaniyat (Kuria Muria Islands) off Oman; Korea and southern Honshu south to Taiwan; New Zealand; southern California south along coast of Baja California and throughout the Golfo de California; the coast of Peru and Northern Chile to 28°S (Rice, 1998; Sanino et al. 2003). Li (1997) reports sightings from the coast of Fujian, China.

Individuals from the eastern North Pacific population—*D. bairdii* Dali, 1873, of past authors—and the southern African population differ from each other in vertebral count and perhaps other characters (Heyning and Perrin 1994); further study of all populations is needed to ascertain whether recognition of subspecies would be worthwhile. (Beware that some authors have haphazardly applied the name *D. bairdii* or *D. delphis bairdii* to all Pacific Ocean Delphinus; Rice, 1998).

3. Population size

Barlow (1995) reports that in Californian waters, between the coast and 555 km offshore, the estimated abundance of *D. capensis* was 9,470 animals, as opposed to a count of 226,000 for *D. delphis*.

4. Biology and Behaviour

Habitat: *D. capensis* seems to prefer shallower and warmer water and occurs generally closer to the coast than *D. delphis* (Perrin, 2002). In Peru and Chile occurence is limited to the continental shelf and typically related to the presence of dusky dolphins *Lagenorhynchus obscurus* (Sanino et al. 2003). One well-studied variation of the long-beaked form is the so-called Baja neritic race: found in the Gulf of California (Sea of Cortez), Mexico, and the eastern tropical Pacific, north of 20°N, this form occurs mainly in shallow waters, 20-180 m deep (Carwardine, 1995).

Food: *D. capensis* off southern California feeds on sardines (*Sardinops coerulea*), anchovies (*Engraulis mordax*), sauries (*Cololabis saira*), small bonitos (*Sarda chiliensis*), and squids (*Loligo opalescens*). Long-beaked common dolphins off southern Africa feed mainly on pilchards (*Sardinops ocellatus*), anchovies (*Engraulis capensis*), and squids (*Loligo v. reynaudii*) but had many other prey species of fishes and squids, including myctophids in their stomachs. There seems to be no obvious difference in the diet between *C. delphis* and *C. capensis* (Ohizumi et al. 1998). Off Brazil, *D. capensis* seems to prefer cephalopods (De Oliveira Santos et al. 2002).

5. Migration

No entries.

6. Threats

No entries.

7. Remarks

Because of past confusion with *D. delphis*, very little is known about this species. Overall distribution, behaviour at sea, movements, reproduction and other key parameters, such as abundance, are poorly known. Threats are presumably similar to those affecting *D. delphis*. The smaller density, however, could reflect that this species is not as frequent as *D. delphis* and thus could be more strongly affected by by-catch in tuna fisheries. See further recommendations on South American stocks in Hucke-Gaete (2000) (see Appendix 1) and on Southeast Asian stocks in Perrin et al. (1996) (see Appendix 2).

D. capensis is not listed by CITES, IUCN or CMS.

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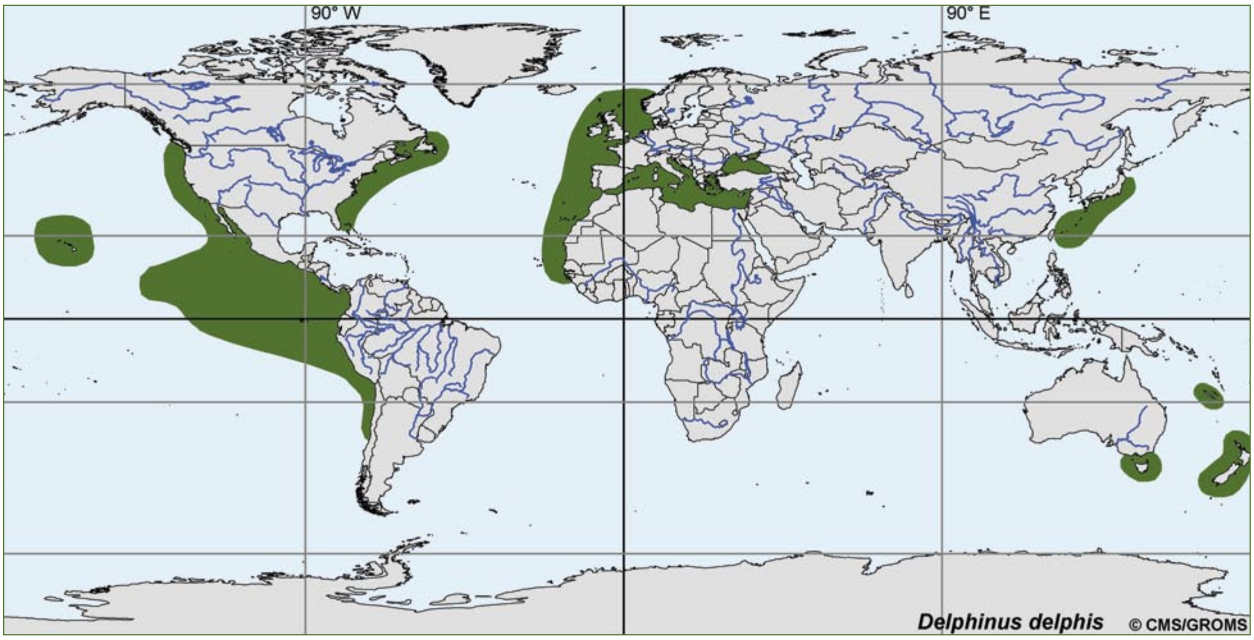
5.9 Delphinus delphis (Linnaeus, 1758)

English: Common dolphin
German: Gemeiner Delphin
Spanish: Delfín común
French: Dauphin commun

Drawing of Delphinus delphis © Wurtz-Artescienza.

1. Description

All common dolphins are slender and have a long beak sharply demarcated from the melon. The dorsal fin is high and moderately curved backwards. Common dolphins are distinguished from other species by a unique crisscross colour pattern formed by interaction of the dorsal overlay and cape. This yields a four-part pattern of dark grey to black dorsally, buff to pale yellow anterior thoracic patch, light to medium grey on the flank and a white abdominal field. In the short-beaked species, the colour pattern is more crisp and colourful than in *D. capensis* or *D. tropicalis*. Body size ranges from 164 to 201 cm and body mass to about 200 kg (Perrin, 2002).



Distribution of the genus Delphinus: warm temperate, subtropical, and tropical waters worldwide (map mod. from Perrin, 2002; © CMS/GROMS).

The common dolphin varies so much in appearance that more than 20 species have been proposed over the years (Carwardine, 1995). The long controversy has been substantially resolved by recent studies, which revealed that the genus consists of at least two species: a short-beaked offshore form (*D. delphis*) and a long-beaked coastal form (*D. capensis*). Each of these species has a wide, but disjunct, distribution in tropical and warm temperate waters; their ranges are mostly parapatric, with some local marginal overlap. In the northern Indian Ocean, an even longer-beaked form with a higher tooth count, *D. tropicalis*, largely replaces *D. capensis* (Rice, 1998 and refs. therein).

Both long-beaked and short-beaked forms also have a wide range of more subtle variations within their own populations. These probably represent distinct races, and are not sufficiently different to grant the animals species status. Races vary mainly in body size—from an average of 1.8 m long in the Black Sea to 2.4 m in the Indian Ocean—and colouring (though most still have an instantly recognisable hourglass pattern on their sides) (Carwardine, 1995).

The population in the Black Sea is separable from those in the Mediterranean and the eastern North Atlantic, and has been described as an endemic subspecies *D. d. pontidus* Barabash, 1935. In the northeastern Pacific, three populations separated by latitude can be distinguished by body length and cranial features. A rare morph with a deviant pigmentation pattern has been found in several areas of the Atlantic and Pacific oceans (Rice, 1998 and refs. therein).

2. Distribution

Delphinus delphis is widely but discontinuously distributed in warm temperate and tropical waters of the Atlantic, Pacific, and probably Indian oceans. Its total distribution is uncertain because of past taxonomic confusion. The confirmed range includes the western North Atlantic from Newfoundland to Florida (all reports of specimens and sightings of *Delphinus sp*. from the Gulf of Mexico are erroneous or unacceptable); the eastern North Atlantic from the North Sea south to Gabon, including the Mediterranean and Black seas; the south-western Pacific around Nouvelle Calédonie, Tasmania, and New Zealand; the western North Pacific from Honshu to Taiwan, thence east in the Kuroshio Extension, between 28°N and 43°N, as far as 160°W (absent from Hawaiian waters); and the tropical and warm temperate eastern Pacific from southern California south to central Chile, and west to about 135°W (Rice, 1998 and refs. therein).

Unidentified *Delphinus spp.* have been observed in many parts of the tropical Indian and western Pacific oceans (Rice, 1998 and refs. therein) such as Port Philip Bay, Victoria, Australia (Scarpaci et al. 1999). The most northerly record from the North Pacific is British Columbia, Canada, and in the North Atlantic, the northern waters of Norway and Sable Island off Nova Scotia (Evans, 1994; Lucas and Hooker, 2000; Syvertsen et al. 1999).

3. Population size

In the eastern tropical Pacific, Perrin et al. (1985, in Reyes, 1991) proposed the division of common dolphins into four stocks, on the basis of morphological differences or distributional gaps: Baja neritic, northern, central, and southern stocks. The proposal of a fifth division ("Guerrero stock") is considered provisional, pending further study. Estimates of the mean seasonal abundance of Delphinus in coastal southern California from Point Conception to Cape Collenette in Baja California are approximately 15,500 in winter-spring and 57,000 in summer-autumn. Estimates for the tropical eastern Pacific range from 220,700 in the west central zone to 1,300,300 in the southern zone. A total of 3,112,300 is estimated for the entire tropical eastern Pacific (Evans, 1994 and refs. therein).

Acording to Anganuzzi and Buckland (1989, in Reyes, 1991) the northern stock was considered stable, the central stock declined and the southern stock fluctuated in size during 1975-1986 (Reyes, 1991, and refs. therein). Barlow (1995) conducted a ship survey in summer and fall of 1991 to estimate the abundance of cetaceans in California waters between the coast and approximately 555 km offshore. The estimated abundances of short-beaked common dolphins was 226,000.

Aguayo et al. (1998) report that in the South Pacific, one of the species mostly sighted between Valparaiso and Easter Island (Rapa Nui), during five cruises made during the winter seasons of 1993 to 1995 was *D. delphis* (1.01 sightings per day amounting to 213 animals per day).

The most recent survey in the northern part of the Black Sea was carried out in 1987 in an area of 70,000 square kilometres between the USSR and Bulgarian borders. Sokolov et al. (1997) conducted a line-transect using four vessels. The extrapolated population density for the whole area of the Black Sea led to an estimated total number of *D. delphis* of 96,000. Stanev (1996), however, reports that the number of sightings in the Bulgarian sector of the Black sea has declined between 1992 and 1995.

Reports from the Mediterranean Sea suggest a decline of common dolphins in the northern part of the western basin. The possible causes may include pollution, overfishing of food resources, unregulated direct exploitation in Spain and indirect catches in Spain, Italy and France (Reyes, 1991). Gannier (1998) conducted 22,769 kilometres of visual line transect on small boat in the ligurian basin (Mediterranean Sea) confirming that common dolphins accounted for only 0,3 % of cetacean sightings. Although the exact cause or causes are uncertain, there is no doubt about the fact that a large-scale population decline has occurred, and that Common dolphins now survive only in relatively small portions of their former Mediterranean range. These latter include the Alboràn Sea, where thousands of animals are still present, and the northern Aegean Sea, where data is scarce but it appears that densities remain fairly high. Otherwise, these dolphins have become rare in, or completely absent from, Mediterranean areas where information is available (Bearzi et al. 2004).

Analyses of stranding records indicate that even though short-term fluctuations have been observed, there has not been a long-term change in the frequency of strandings in the North Sea.

A sighting survey conducted in the Bay of Biscay in 1993 led to a population estimate of 62,000 common dolphins in the fishing grounds of the albacore tuna driftnet fishery (Goujon, 1996).

4. Biology and Behaviour

Habitat: *D. delphis* is usually found where surface water temperature is between 10°C-20°C, which limits the distribution north and south of the range, but it may follow warm water currents beyond the normal range. It is less commonly seen in water shallower than 180 m. *D. Delphis* occurs over the continental shelf, particularly in areas with high seafloor relief, but mainly offshore (Carwardine, 1995). Off southern California the offshore form is associated with conspicuous features of the bottom relief such as sea mounts and escarpments, preying at night on organisms associated with the deep-scattering layer. In the eastern tropical Pacific they prefer equatorial and subtropical waters with a deep thermocline, relatively large seasonal changes in surface temperature and seasonal upwelling. In the Black Sea, common dolphins may be found either in inshore waters or in the open sea (Reyes, 1991 and refs. therein).

Bourreau and Gannier (2003) found that Mediterranean common dolphins were more frequent in coastal and upper slope waters, the mean depth for sighting being 480 m. Common dolphins were likely to be observed in areas where the continental shelf had some extension and was delimited by a gentle slope, whatever the temperature, a habitat type also favourable to small epipelagic fishes such as anchovies and sardines. Stomach contents results available in the literature clearly indicate a preferendum of *D. delphis* for such preys, compared to the more teuthophageous and opportunistic striped dolphin.

Schooling: Often found in large, active schools: jumping and splashing can be seen and even heard from a considerable distance. Several members of a group often surface together. School size often varies seasonally and according to the time of day. Animals bunch tightly together when frightened (Carwardine, 1995). Herds range in size from several dozen to over 10,000. Associations with other marine mammal species are not uncommon (Jefferson et al. 1993).

Reproduction: Breeding peaks in spring and autumn or summer have been reported for some stocks (Jefferson et al. 1993). Ferrero and Walker (1995) found that calving in the offshore waters of the North Pacific appeared to peak in May and June.

Food: The prey of common dolphins consists largely of small schooling fish (e.g. sardines) and squid. Cooperative feeding techniques are sometimes used to herd fish schools (Jefferson et al. 1993; Silva, 1999). Off southern California common dolphins eat mainly anchovies and squids during the winter, but in spring and summer deep-sea smelt and lanternfish are preferred. Epi- and mesopelagic fishes and squids are eaten in the western Mediterranean. In the Black Sea this species is typically ichthyophagous, with horse mackerel, anchovy, sprat, mullet and jack mackerel as the main prey items. Other organisms such as crustaceans and benthic molluscs are considered of minor importance (Reyes, 1991, ad refs. therein).

Based on radio-telemetric studies and analysis of stomach contents, common dolphins off southern California start feeding at dusk and continue to feed throughout the night. They feed primarily on organisms in the migrating deep scattering layer (Evans, 1994). Deep scattering layer organisms, especially myctophiids and bathylagiids, represent one of the major biomasses in the world's oceans. Their world-wide distribution, abundance and the possible lethargic behaviour of many species make them an ideal prey for most of the pelagic delphinids (Evans, 1994 and refs. therein).

Young and Cockroft (1994) report that in Natal the occurrence of common dolphins is strongly associated with an annual, northward fish migration, the sardine run, along the east coast. Thirty-six fish and four cephalopod prey species were identified in stomach samples. Though 86.9% by weight of the diet was made up of only five prey species, common dolphins appear to feed opportunistically, their diet reflecting local prey abundance and availability. Prey were primarily small, easily-caught, pelagic shoaling species, the main prey being South African pilchard (*Sardinops ocellatus*).

5. Migration

Migrations are not well known and common dolphins are present year round in some parts of their range. Clear seasonal shifts in distribution are observed off southern California, where peaks of abundance are recorded in June, September through October, and in January. Sighting data also suggest seasonal movements of common dolphins in the eastern tropical Pacific. Common dolphins spend the winter in the southern part of the Black Sea, between Trabzon and Batumi, and perform annual migrations from these wintering grounds to the waters of Crimea and back. Seasonality in prey availability may explain these movements. Sightings in the western Mediterranean also indicate seasonal patterns in distribution. Common dolphins are more frequently observed in the southern part of the Mediterranean during the first half of the year. In the northern part of the Sea, sightings increase during the second half of the year (Reyes, 1991 and refs. therein).

Radio-telemetric and other studies (see Evans, 1994 for details) have indicated that common dolphins preferentially travel over underwater escarpments. In the Pacific Ocean off southern California and Baja California, Mexico, the main movement patterns are north-south, along the prominent bottom topographic features such as escarpments and sea mounts. In the Mediterranean these topographic features are oriented east-west. Evans (1994) observed large herds of Delphinus (>200) from the Straits of Gibraltar to the Azore Platform moving west at sunrise and east at sunset.

Braeger and Schneider (1998) investigated the near-shore distribution and abundance of common dolphins off the West Coast of New Zealand's South Island. *Delphinus delphis* occurred almost exclusively in summer in groups of 2-150 individuals, often with calves, especially at Cape Foulwind and Jackson Head, suggesting a seasonal preference for this coast.

Neumann (2001) reports a seasonal offshore-shift in short-beaked common dolphins in New Zealand, which appears to be correlated with sea surface temperature. *D. delphis* moved from a mean distance of 9.2 km from shore in spring and summer to a mean distance of 20.2 km from shore in autumn. During warmer La Niña conditions, mean distance from shore was reduced to only 6.2 km, and offshore movement was delayed by a month. It is hypothesised, that SST influences the distribution of *D. delphis* prey, which in turn affects their seasonal movements.

Goold (1998) used passive acoustic monitoring of common dolphins off the west Wales coast during the months of September, October, November and December 1994 and 1995. Distributions of common dolphins within the survey area showed a marked decrease in dolphin contacts between September and October of both years. These observations suggest offshore migration of the populations at that time of year. It is hypothesised that offshore migration of common dolphins coincides with a break-up of the Celtic Sea Front, a distinct oceanographic feature which crosses the survey area. Goold (1996) reports on south-westerly migratory behaviour of common dolphins monitored acoustically in the North Sea in the fall of 1995. Collet (1981, in Collet, 1994) supposes that *D. delphis* spends the winter on the French coast of the Bay of Biscay and leaves this area after March.

Scott and Cattanach (1998) used data collected by scientific technicians aboard tuna purse seiners in the eastern Pacific Ocean since the early 1970s to study the biology and herd dynamics of pelagic dolphins. A pattern of increasing group size in the morning and subsequent decline in the late afternoon or night was evident for common dolphins, as well as for large yellowfin tuna that associate with dolphins. It appears that these diel patterns are produced by an interaction of predation pressure and prey distribution.

Goncalves et al. (1996) report on a strong seasonality of *D. delphis* strandings on the Azores between February and April 1996.

Goffman et al. (1995) surveyed wild dolphins along the Mediterranean coast of Israel. Common and striped dolphins as well as calves accompanying adults were reported mainly during the summer and early fall. Seventy-one percent of the reports came from the southern portion of the Mediterranean coast of Israel (south of Netanya). The reason for this spatial distribution is unknown. Factors associated with food availability or increased activities of large vessels off the northern coast are possible explanations.

Gowans and Whitehead (1995) report on seasonality of common dolphin abundance in the Gully off Nova Scotia. The animals arrive in July, when water temperatures have increased. Delgado-Estrella (1994) report that strandings on the Californian coasts of Mexico peak in spring. This could be associated with the increase of the fishery activities or by the higher abundance in number of animals and number of species in this part of the Gulf of California.

6. Threats

Direct catch: A fishery for three species (common dolphin, bottlenose dolphin and harbour porpoise) operated in the Black Sea from 1870 to 1983, in the USSR and Turkey. However, the question as to the extent of this fishery is as yet unresolved. Direct catches of common dolphins are also reported from several other areas. In Peru, where dolphins are used for food, about 50% of the 264 landed in a single port in 1987 were harpooned. Although direct killing has noticeably decreased in Peru since dolphin hunting was banned by law in 1996, around a thousand dolphins and other small whales are still falling victim annually to fishermen to supply bait meat for the shark fishery (2003, see mundo azul in "selected web-sites").

In the western Mediterranean, small numbers were taken off Spain up to 1988 when this practice was banned. Off the Atlantic coast of France, some were harpooned by fishermen for consumption at sea. Other reported takes come from Japan and elsewhere in the range (Reyes, 1991 and refs. therein; Jefferson et al. 1993).

Incidental catch: The common dolphin is one of the most prominent by-catches of both the world-wide pelagic purse-seine and drift net fisheries. This is due in part to its abundance and possibly because of a shared feeding ecology with the targets of those fisheries, large migratory pelagic fish (e.g. tuna). The largest impacts have been in the eastern Pacific and the Indian Ocean and Mediterranean, with some takes associated with the tuna purse-seine fishery off the west coast of Africa. In 1988 an estimated 16,189 common dolphins were killed in the eastern tropical Pacific tuna purse-seine fishery. Although this is less than 0.5% of the total population, the catch could be highly detrimental if each herd is a genetically discrete breeding population (Evans, 1994 and refs. therein).

The average herd size for common dolphins (approx. 500) is greater than that for the other stocks or species, and their more active diving behaviour in the net makes them more susceptible to becoming trapped or tangled. In the 1980's, 4.9% of the sets in the fishery involved common dolphins, but in the 1990's this proportion increased. This indicates that the fishing effort concentrated in areas where the species was more abundant, mainly as a result of enlargement of the Mexican fleet. A large part of the sets on common dolphin schools occurs in coastal waters, where stock structure and movements are poorly understood, and three or more populations may be involved (Reyes, 1991 and refs. therein).

Drift net fishery for swordfish in the waters surrounding the Italian Peninsula is estimated to kill thousands of dolphins and it is likely that common dolphins are caught in these nets. Silvani et al. (1999) calculated that by-catch rates of the illegal Spanish driftnet fishery operating since 1994 on the Mediterranean side of the Gibraltar Straits, aimed at swordfish (*Xiphias gladius)* amounted to 366 dolphins for the 1993 fishing season and 289 for that of 1994. If these figures are added to the undetermined catches of dolphins by the Italian and Moroccan driftnet fleets also operating in the region, it is possible that these catches are not sustainable.

Small-scale incidental catches in gillnets occur elsewhere in the range. Some are taken in trawl and purse seine fisheries, particularly in the Black Sea and waters off Northwest Africa, South America and New Zealand

(Reyes, 1991, and refs. therein). This is confirmed by by-catch assessments from various sources: Antoine et al. (2001), from the north-east Atlantic, Chivers et al. (1997) from California, Berrow and Rogan (1998) and Couperus (1997) from Irish waters, Goffman et al. (1995) from the Mediteranean coast of Israel, and Kuiken et al. (1994) from the coast of Cornwall, England and Crespo et al. (2000) for Argentinian waters.

Tregenza and Collet (1998) found that pelagic trawl bycatches of dolphins are widespread in the Bay of Biscay, Western Approaches and Celtic Sea and are likely to be the largest of several fishery bycatches of common dolphins which together probably exceed 1% of the local summer population. Strandings records indicate recurring heavy mortalities of common dolphins in fisheries in this area. Further observations are particularly needed of winter pelagic trawl fisheries in Biscay and the Western Approaches. Systematic tagging of discarded by-caught animals would help to make strandings data more meaningful.

In 1992 and 1993, a programme of observers allowed to estimate that on average 1.7 common dolphins were incidentally caught per trip by the French driftneters targetting albacore tuna off the Bay of Biscay. The annual additional mortality linked to the driftnets was estimated at 0.8%, a diminution in abundance which is probably sustainable (Goujon, 1996).

Tregenza et al. (2003) analysed stranding records in the southwest of England and found for both common dolphins and porpoises a disproportionate increase in the first four months of the year since 1970. In both species a small, non-significant, fall in male length and a similar increase in female length is recorded. The authors suggest that a) Strandings are still substantially under-reported. b) A recent real rise in common dolphin bycatch is likely. c) A mark-recapture or body loss rate approach to strandings might provide a useful basis for assessing true strandings rates. d) Rigorously recording the reliability status of species, length, and sex data will enhance the long term value of these records. e) Marking of discarded cetaceans by fisheries observers would be immensely valuable but is still not routinely practised. f) Accessible data on fishery location, effort and method would be valuable.

In northern Portuguese waters a total of 77 cetacean strandings were recorded betweeen 2000 and 2002, involving 7 different species. The common dolphin was the species most commonly recorded with 60% (n=-46) of all strandings reported, followed by the harbour porpoise with 19% (n= 15). Confirmed bycatch was responsible for 34% of all strandings and up to 18% of the deaths were suspected to have been caused by interactions with artisanal fishing gear (Ferreira et al. 2003).

Batten and Hall (1997) summarise that in the tuna purse seine fisheries, tuna and dolphins are herded and captured together in the net. Prior to retrieving the entire net and the tuna, the crew attempt to release the dolphins by a procedure called "backdown," while utilising various dolphin safety gear. Though a great majority of the dolphins are released unharmed, some die during the fishing operation. Since 1986, dolphin mortality has been reduced by 97%. Analyses of observer data show that many factors cause dolphin mortality, such as fishing areas; dolphin species and herd sizes; environmental factors; gear malfunctions; and crew motivation, skill, and decision-making. Given this, it is clear that there can be no simple solution to this problem. A combination of major and minor technological developments, training in their use, better decision-making skills, and constant pressure to improve performance are the basis of the current success.

Culling: In the western Mediterranean, in particular off the coast of Spain, fishermen use harpoons to kill common dolphins and other small cetaceans that cause damage to fishing gear. Dolphins are considered a nuisance in the Black Sea, where they are said to consume an amount of fish greater than Turkey's annual fish production (Reyes, 1991).

Pollution: Pollution has increased dramatically in the Azov Sea, and this is the reason why common dolphins are no longer found there. Large amounts of domestic and industrial effluents are dumped in the Mediterranean, and some areas are under severe ecological stress. High concentrations of PCBs were found in one common dolphin stranded on the French Mediterranean coast showing the level of contamination of these waters (Reyes, 1991 and refs. therein). Bioaccumulation of this family of man-made contaminants has also been recorded from *Delphinus* stranded in US waters (Evans, 1994 and refs. therein).

Long et al. (1997) analysed cadmium levels in *Delphinus delphis* from South Australia. Cadmium was accumulated mainly in the kidneys (range 0-38 µg/g), with levels in many individuals exceeding 20 µg/g (wet weight). On histological examination, 32% of adult dolphin kidneys showed pathological changes, proteinuria being the most common abnormality. High levels of cadmium were found in dolphins from widely spaced locations in South Australia. Holsbek et al. (1998) investigated Heavy metal concentrations (total and organic Hg, Ti, Cr, Cu, Zn, Cd and Pb) in 29 common dolphins stranded on the French Atlantic coast and found no difference in contamination between the 1977-1980 and 1984-1990 periods.

Moessner and Ballschmiter (1997) determined polychlorinated biphenyl levels in a variety of marine mammal species, including *D. delphis*. When comparing the xenobiotic levels of these marine mammals, it showed that the animals from the western North Atlantic were contaminated about 15 times more with organochlorines than the animals from the eastern North Pacific and the Bering Sea/Arctic Ocean. The total organochlorine burden, the 4,4'-DDE-percentage as well as the metabolic PCB patterns correlate with the trophic levels of the marine mammals studied. Viale (1994) even suggests using cetaceans as indicators of the progressive degradation of Mediterranean water quality.

Habitat degradation: Evans (1994) fears that the development of the offshore petroleum industry is likely to have a negative effect on pelagic cetacean species such as *D. Delphis*, and Goold (1996) confirms this, describing the avoidance reaction of *D. Delphis* to airguns used in the corresponding seismic surveys.

Overfishing: In many areas, including the Mediterranean and Black Seas, common dolphins feed on schooling fish that are also the target for commercial fisheries. In the Black Sea, concern has been expressed about the recent increase in the anchovy and sprat fisheries, the main food supplies of the isolated population of common dolphins already overexploited by a direct fishery (Reyes, 1991 and refs. therein). According to Bourreau and Gannier (2003) The apparent rarefaction of common dolphins in the Mediterranean Sea may be due to heavy exploitation of peri-coastal stocks of pelagic fishes. This suggests suitable conservation policies for the near future in regions where the species is still well represented.

7. Remarks

Common dolphins are protected both directly and indirectly in several countries through national legislation. International efforts include the Convention on Marine Resources of the Black Sea established in 1966 by the USSR, Romania and Bulgaria to evaluate the populations of small cetaceans of the Black Sea whose depletion had been observed since the late 1930s (Reyes, 1991). Oeztuerk (1996) summarises that Turkey is preparing a long term action plan to protect dolphins in the Black Sea. This program consists of four main approaches: research and monitoring, establishment of special protected areas, enforcement of the fisheries regulation, and public awareness campaigns (DBO).

Another matter of concern is the continuing high mortality of common dolphins in pelagic purse-seine and drift net fisheries world-wide. Further observations are particularly needed of winter pelagic trawl fisheries in the Bay of Biscay and the Western Approaches. Systematic tagging of discarded by-caught animals would help to make strandings data more meaningful (Tregenza and Collet, 1998).

See further recommendations for South American stocks in Hucke-Gaete (2000) and for Southeast Asian stocks in Perrin et al. (1996) in Appendix 1 and 2 respectively.

The North and Baltic Sea populations, the western Mediterranean sea population, the Black Sea population and the eastern tropical Pacific population of *Delphinus delphis* are listed in Appendix II of CMS.

However, recent data indicate that the species also migrates in the Strait of Gibraltar area (Range states: Spain, Portugal, Algeria, Morocco), along the coast of southern California (Range States US, Mexico), and in the Nova Scotia area (Range states US and Canada). It is therefore recommended that the species as a whole should be included in App. II of CMS, without restriction to particular stocks.

The Mediterranean sub-population is listed as endangered by the IUCN.

Range States for the Black Sea population are Bulgaria, Ukraine, Romania, Turkey and for the western Mediterranean Algeria, France, Italy, Malta, Monaco, Morocco, Spain and Tunisia. Range States for the ETP Populations are Colombia, Costa Rica, Ecuador, El Salvador, France (Clipperton Islands), Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Spain, and the United States (Reyes, 1991).

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5.10 Delphinus tropicalis (van Bree, 1971)

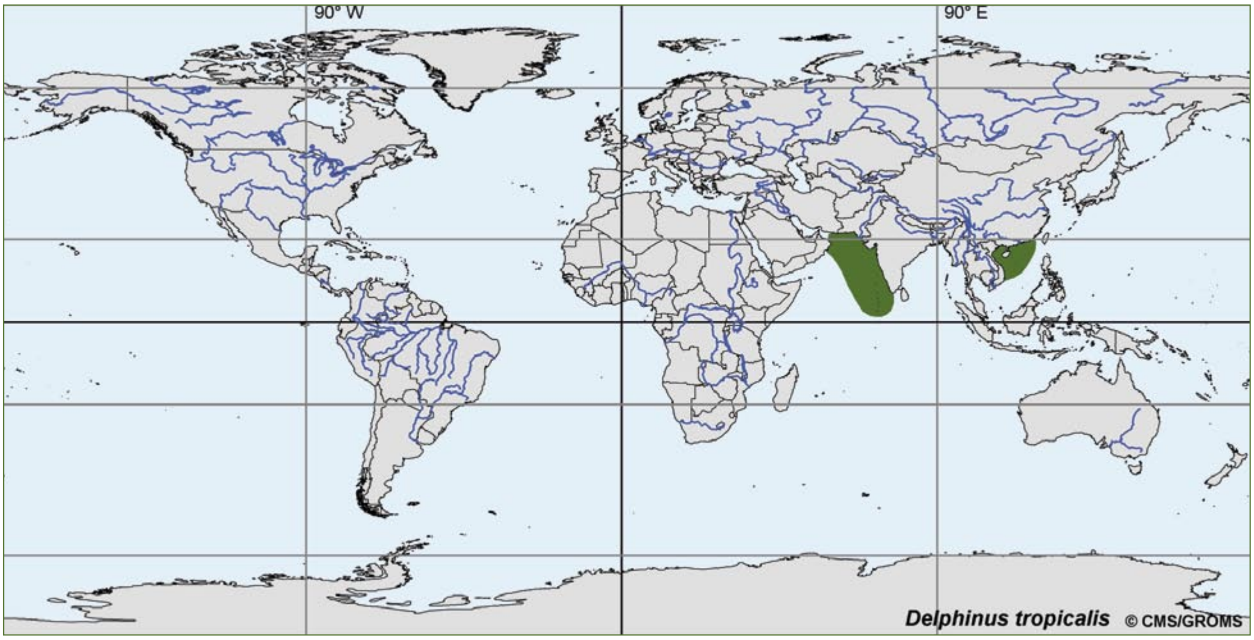
English: Arabian common dolphin
German: Arabischer gewöhnlicher Delphin
Spanish: Delfín común árabe
French: Dauphin commun de l'Arabie

Drawing of *Delphinus tropicalis* © Wurtz-Artescienza.

1. Description

All common dolphins are slender and have a long beak sharply demarcated from the melon. The dorsal fin is high and moderately curved backwards. Common dolphins are distinguished from other species by a unique crisscross colour pattern formed by interaction of the dorsal overlay and cape. This yields a four-part pattern of dark grey to black dorsally, buff to pale yellow anterior thoracic patch, light to medium grey on the flank and a white abdominal field. In the long-beaked species, the colour pattern is less crisp and colourful than in *D. delphis* (Perrin, 2002).

Although Heyning and Perrin (1994) recognised that the putative *D. tropicalis* had a longer rostrum and higher tooth count than any of the *D. capensis* they analysed, they deferred judgement on the validity of



Distribution of Delphinus tropicalis (mod. From Perrin, 2002): Arabian Sea and South China Sea; © CMS/GROMS.

the species until more specimens became available. More recently, a limited morphological analysis suggested that the *tropicalis* type is, in fact, only a long-beaked form of *D. capensis*. Although the taxonomic status of *D. tropicalis* is unclear, Ballance and Pitman (1998) found it clearly separable in the field from both *D. capensis* and *D. delphis*.

Heyning and Perrin (1994) suggested that *D. tropicalis* may have a colour pattern similar to that of *D. capensis*, but Ballance and Pitman (1998) found *D. tropicalis* lacked both the heavy black stripe coming forward on the sides from the vent and the black or smudgy face patterning often visible among individuals in large schools of *D. capensis. D. tropicalis* was separable from *D. delphis* by the extreme length of the rostrum alone (even longer than that of *D. capensis*). The overall impression was that *D. tropicalis* has a *D. capensis* body shape (but with a noticeably longer beak) and a *D. delphis* colour pattern.

2. Distribution

Coastal waters of the Arabian Sea, from the Gulf of Aden and the Persian Gulf to the Malabar Coast of India; South China Sea. This taxon was formerly called *D. longirostris* Cuvier, 1829, and *D. dussumieri* Blanford, 1891, but both names are preoccupied (Rice, 1998; van Bree, 1978).

Casinos (1984) reports on ten skulls of *Delphinus sp.* from the South American Atlantic coast. All of them present a high number of teeth: no less than 43 for each branch of the jaws, the upper limit being 60. The highest numbers of teeth apply to specimens from Brazil. In these specimens the relative length of the rostrum and the index length of the rostrum divided by zygomatic width yield the maximum values quoted for *Delphinus sp.* However, this may qualify for *D. capensis* rather than for *D. tropicalis*.

3. Population size
no entries.

4. Biology and Behaviour
no entries.

5. Migration
no entries.

6. Threats
no entries.

7. Remarks
This species is insufficiently known and is not listed by IUCN or CMS.

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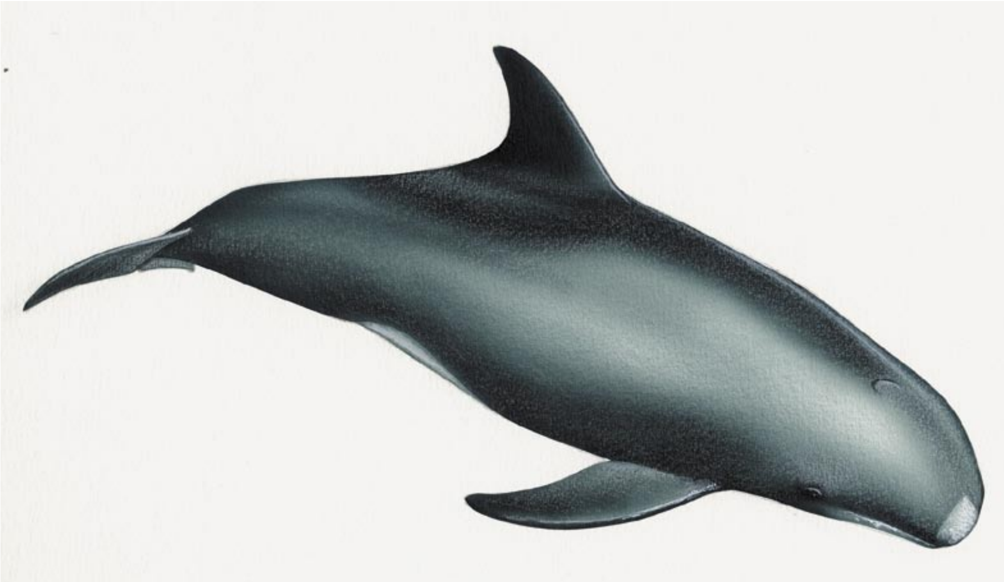
5.11 Feresa attenuata (Gray, 1874)

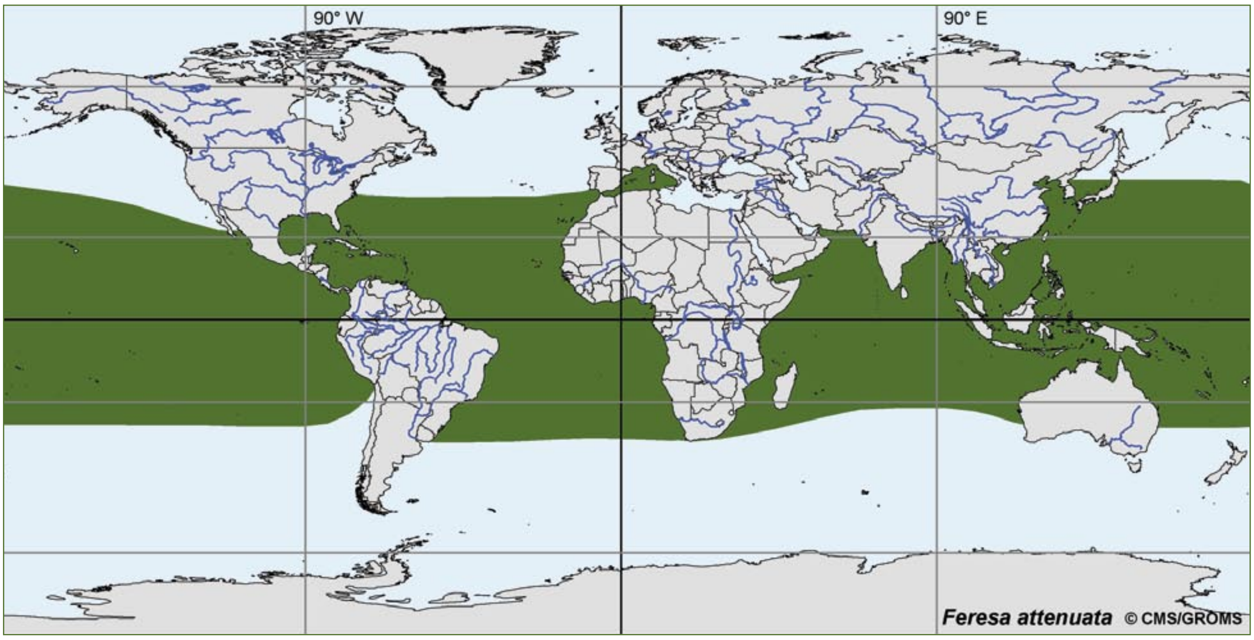
English: Pygmy killer whale
German: Zwerggrindwal
Spanish: Orca pigmea
French: Orque pygmée



Drawing of Feresa attenuata © Wurtz-Artescienza.

1. Description

Pygmy killer whales have a robust body that narrows towards the dorsal fin, hence the name "*attenuata*" (latin) meaning "thinning". The head is round and blunt and lacks a beak typical of many dolphin species. The moderately long flippers are rounded at the tips with convex leading and concave trailing edges. Pygmy killer whales are mostly grey to black, with a subtle dark cape on the side, below the high, falcate dorsal fin. There is a paler grey area on each flank and an irregularly white patch on the ventral side between the flippers, around the genitals and occasionally the tail stock. The lips are also edged with white. Body size ranges from 2.1 to 2.6 m (Donahue and Perryman, 2002).



Distribution of Feresa attenuata (mod. from Jefferson et al. 1993; © CMS/GROMS). The species prefers tropical and subtropical offshore waters around the world (Carwardine, 1995).

2. Distribution

This is a tropical and subtropical species that inhabits oceanic waters around the globe, generally not ranging north of 40°N or south of 35°S (Jefferson et al. 1993). It ranges north to the Gulf of Mexico, east coast of Florida, Senegal, Arabian Sea, Sri Lanka, Honshu, Hawaii, and Gulf of Tehuantepec, and south to Buenos Aires, Cape Province, Queensland, and Peru (Rice, 1998).

The distribution of *F. attenuata* is poorly known from sparse but widely distributed records worldwide. It is seen relatively frequently in the eastern tropical Pacific, Hawaii, and Japan, though it is not particularly abundant anywhere. Because it tends to avoid boats it may be more common than the records suggest (Carwardine, 1995).

It is notable that most of the records outside the tropics are associated with strong, warm western boundary currents which effectively extend tropical conditions into higher latitudes. Records of whales on the cool west coasts of southern Africa and Peru are exceptions, though these could well have originated in far warmer waters comparatively close by (Ross and Leatherwood, 1994 and ref. therein).

3. Population size

Nothing is known of population limits, size, or structure for this species (Ross and Leatherwood, 1994, and refs. therein).

4. Biology and Behaviour

Habitat: Occurs in deep, warm waters, rarely close to shore (except near oceanic islands). Mainly tropical, but occasionally strays into warm temperate regions (Carwardine, 1995).

Behaviour: *F. attenuata* may be difficult to approach and is known to avoid boats, though there are reports of bow- and wake-riding (Carwardine, 1995).

Schooling: Groups generally contain 50 or fewer individuals, although herds of up to several hundred have been seen. It is a slow and lethargic animal compared to the similar-appearing melon-headed whale (Jefferson et al. 1993; Ross and Leatherwood, 1994). Pods often swim abreast in perfectly co-ordinated "chorus lines" and, when alarmed, bunch together to rush away. Growling sounds may be heard above the surface. Herds often strand (Carwardine, 1995), e.g. at Hawaii (Mazzuca et al. 1999) or in Brazil (Zerbini and de Oliveira 1997). A new record of a mass stranding of pygmy killer whales from the British Virgin Islands was documented by Mignucci-Giannoni et al. (2000), associating the stranding process with the meteorological and oceanographic disturbance of hurricane Marilyn, which devastated the Virgin Islands a day prior to the stranding.

Food: Pygmy killer whales eat mostly fish and squid, although they occasionally attack other dolphins, at least when those dolphins are involved in tuna fishery interactions in the eastern tropical Pacific (Jefferson et al. 1993; Carwardine, 1995). Santos and Haimovici (1998) found mainly squids of the families Onychoteuthidae and especially Ommastrephidae in the stomach contents of *Feresa attenuata*.

5. Migration

No migrations are known (Carwardine, 1995). Incidental catches by Sri Lankan fishermen have been reported in monitored portions of the gillnet fisheries in all months except September, November and December, indicating that pygmy killer whales are present almost throughout the year in this region. Similarly, whalers of St Vincent, Lesser Antilles, indicated that they might encounter pygmy killer whales at any time of the year, implying residency. Though dated records for several other regions span several months of the year, they are at present too few to permit assessment of the migratory status of this species (Ross and Leatherwood, 1994).

6. Threats

Direct catch: A few individuals are known to be taken in drives and in driftnets in various regions, most notably Japan and Sri Lanka (Jefferson et al. 1993). Reports on the small cetacean fisheries of St Vincent and Lamelera suggest that pygmy killer whales form a very small proportion of the catch, and that catches probably have little impact on the populations in those areas. In Sri Lanka, there is additional mortality of this and other species due to harpooning of dolphins for use as bait on long-lines for sharks, billfish, and other oceanic fishes (Ross and Leatherwood, 1994 and refs. therein).

Incidental catch: Although they comprise less than 2% of all cetaceans in monitored by-catches in gillnet fisheries in Trincomalee, Sri Lanka and in villages on the south-west coast of Sri Lanka, this may amount to

300-900 of the 15,000-45,000 dolphins estimated to die each year in such fisheries (Ross and Leatherwood, 1994, and refs. therein). The numbers of animals killed incidentally in net fisheries, such as those in Sri Lanka, may be much higher than is so far documented because monitoring of these widespread activities is incomplete. In the long term, such takes may have a significant impact on stocks resident in areas where pygmy killer whales (and other small cetaceans) and extensive gillnetting operations overlap (Ross and Leatherwood, 1994). Small incidental catches are known in fisheries in other areas (Jefferson et al. 1993), e.g. the Philippines (Dolar et al. 1999).

Pollution: There are reports on the presence of hydrocarbon residues, including DDT, Dieldrin and PCBs in various tissues of three pygmy killer whales from the Gulf and Atlantic coasts of Florida (Ross and Leatherwood, 1994 and refs. therein).

7. Remarks

There is very little knowledge about this species, its abundance, migratory behaviour or by-catch rates in offshore fisheries. For South American populations, see recommendations in Hucke-Gaete (2000) (see Appendix 1). General recommendations on Southeast Asian stocks can be found in Perrin et al. (1996) (see Appendix 2).

IUCN Status: "Data Defficient".

Not listed by CMS.

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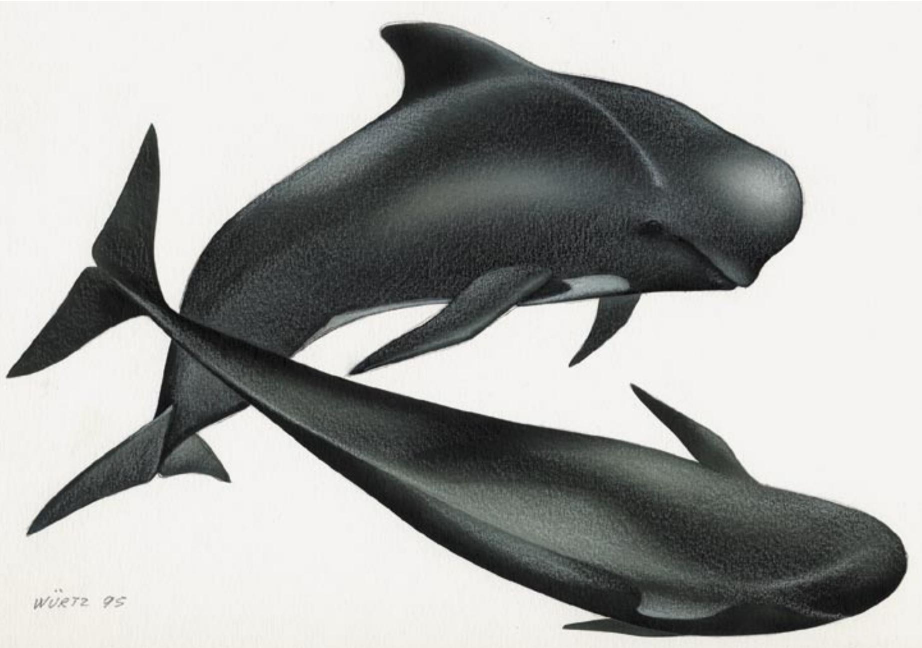
5.12 Globicephala macrorhynchus (Gray, 1846)

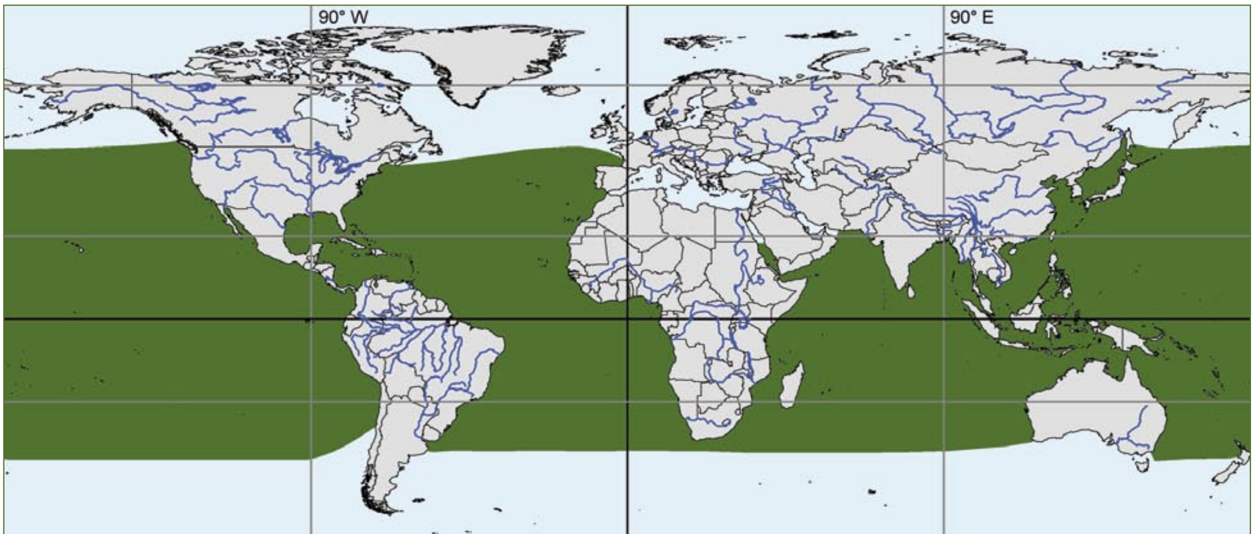
English: Short-finned pilot whale
German: Kurzflossen Grindwal
Spanish: Calderón de aletas cortas
French: Globicéphale tropical



Drawing of Globicephala macrorhynchus © Wurtz-Artescienza.

1. Description

The body in pilot whales is robust, with a thick tail stock. The melon is exaggerated and bulbous and the beak is barely discernible or non-existent. The dorsal fin is wide, broad based, falcate and set well forward on the body. The flippers are long, slender, and sickle-shaped. A faint grey saddle patch may be visible behind the dorsal fin. A grey midventral line extends to the front into an anchor-shaped chest patch and widens posteriorily to a genital patch. The short-finned pilot whale has a wider skull than the long-finned species (Olson and Reily, 2002).



Distribution of Globicepahala macrorhynchus (mod. from Olson and Reilly, 2002; © CMS/GROMS): tropical, subtropical, and warm temperate oceans round the world (Carwardine, 1995).

Long- and shortfinned pilot whales (*G. melas* and *G. macrorhynchus*) are difficult to distinguish at sea. However, both species differ, as the name suggests, in flipper length, skull shape and number of teeth. On average, the pectoral fins of the short-finned pilot whales are 1/6 the body length. Adults reach a body length of approx. 6 m, males being larger than females (Olson and Reily, 2002).

2. Distribution

G. macrohynchus is probably circumglobal in tropical and warm temperate waters. In the Atlantic it ranges north to New Jersey and to Charente-Maritime in France (it is not present in the Mediterranean); in the Pacific, its range extends north into cooler temperate waters as far as Hokkaido (50°N, 145°W), and Vancouver Island. The southern limits of the range are not fully determined due to past confusion with the *G. melas*, but *G. macrohynchus* is known to range south to São Paulo, Cape Province, Western Australia, Tasmania, and Cape Farewell on North Island in New Zealand (Rice, 1998). Short-finned pilot whales are found in deep offshore areas and usually do not range north of 50°N or south of 40°S (Jefferson et al. 1993). There is some overlap in range between the two species (Carwardine, 1995). *Globicepahala macrorhynchus* is vagrant to the Alaska Peninsula (57°N, 156°W) (Rice, 1998). There are hypotheses that the short-finned pilot whale is in the process of expanding to fill the former range of long-finned pilot whales in the North Pacific (Bernard and Reilly, 1999 and refs. therein).

G. macrohynchus appears to vary geographically, but no comprehensive study has been undertaken. Off the Pacific coast of Japan, a northern and a southern population differ sharply in colour pattern and in body size and shape and also in cranial features. However, their taxonomic status remains unsettled (Rice, 1998 and refs. therein; Olson and Reilly, 2002). Water temperature seems to be the primary factor determining the relative distributions of these two populations (Fullard et al. 2000).

3. Population size

Several aerial line-transect surveys of short-finned pilot whales were conducted off the coast of California during the late 70s-early 80s. The size of the population was estimated at between 200 and 4,000, but it is not clear if this represents one or more than one stock. The abundance of short-finned pilot whales in the eastern tropical Pacific was estimated to be 160,000 from an extensive series of line-transect sighting surveys. Off the coast of Japan, line-transect analysis of sightings data from 1984-1985 yielded an estimate of 5,300 for the northern form and 53,000 for the southern form (Bernard and Reilly,1999 and refs. therein). Dolar (1999) estimated a total of 7,700 individuals in the eastern Sulu Sea.

4. Biology and Behaviour

Behaviour: Entire pods can sometimes be seen logging, allowing close approach by boats. The strong blow may be visible in calm weather (Carwardine, 1995).

Habitat: The species prefers deep water and occurs mainly at the edge of the continental shelf, and over deep submarine canyons (Carwardine, 1995). Davis et al. (1998) found that *G. macrorhynchus* in the Gulf of Mexico preferred water depths between 600 and 1,000 m.

Schooling: Pods of up to several hundred short-finned pilot whales have been reported, and members of this highly social species are almost never seen alone. Strong social bonds may partially explain why pilot whales are among the species of cetaceans that most frequently mass-strand. Although detailed studies of behaviour have only begun recently, pilot whales appear to live in relatively stable female-based groups (Jefferson et al. 1993). Three types of social organisation for pilot whale pods off southern California were described: travelling/hunting groups, feeding groups, and loafing groups. The travelling/ hunting groups have also been appropriately described as "chorus lines" as the animals in these are oriented in a broad rank of up to 2 miles in width, but only a few animals deep. Sexual and age-class segregation also have been observed in chorus lines. In the second type of group described, the feeding group, there was sometimes general movement of whales in a given direction, but individuals tend to remain fairly independent of one another. The third type of pod, the "loafing group", was described as an almost stationary aggregation of 12-30 or more individuals, floating at the surface, nearly or actually touching one another. A wide variety of types of behaviour, including mating, was reported to occur in loafing groups (Bernard and Reilly, 1999 and refs. therein).

In the eastern tropical Pacific, approximately 15 % of pilot whale sightings include other cetaceans. They are sighted with bottlenose dolphins (*Tursiops truncatus*) and with tuna-dolphin aggregations (*Thunnus albacares* and *Stenella* spp.) and *S. coeruleoalba*. The most common associate in coastal waters is the bottlenose dolphin; pilot whales have been sighted also with common dolphins (*Delphinus delphis*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), gray whales (*Eschrichtius robustus*), fin and sperm whales (*Balaenoptera physalus* and *Physeter catodon*) and with killer whales (*Orcinus orca*; Bernard and Reilly, 1999 and refs. therein).

Mazzuca et al. (1999) found that in the Hawaiian Archipelago, short-finned pilot whales stranded in the largest groups and experienced the greatest number of stranding events (x = 14 animals, 5 events) of all ceataceans recorded from 1957 through 1998. The greatest incidence of odontocete mass strandings occurred on the Island of Maui during the month of June. Mass strandings occurred on all high Hawaiian Islands, except Hawaii; none were reported on the islands or atolls north of Kauai. Two-thirds of the events occurred on the leeward sides of the islands with similar bottom topography, coastal configuration, and geomagnetic characteristics in all events.

Mignucci et al. (1999) report that in waters off Puerto Rico and the US and British Virgin Islands, short-finned pilot whales were one of the most frequently stranded species. A high number of strandings occurr in the winter and spring.

Food: Although they also take fish, pilot whales are thought to be primarily adapted to feeding on squid (Hacker, 1992). They show the tooth reduction typical of other squid-eating cetaceans (Jefferson et al. 1993). Hernandez-Garcia and Martin (1994) found that stomach contents of two short-finned pilot whales found on the Canary Islands were made up entirely of cephalopods: *Todarodes sagittatus*, *Cranchia* and juveniles of *Megalocranchia*.

Baird et al. (2003) tested the hypothesis that this species also feeds on vertically migrating prey, with deep dives at dusk and dawn following vertically migrating prey, and near-surface foraging at night, using suction-cup attached time-depth recorders (TDRs) and video camera systems (Crittercam). The deepest dives recorded (typically 600-800 m, max. 27 minutes) were during the day. Such deep dives were recorded for all 5-individuals where TDRs remained attached for extended periods. At night, all whales dove regularly to between 300 and 500 m, and the rate of deep (>100 m) dives at night was almost four times greater than during the day. Long bouts of shallow (<100 m) diving occurred only during the day. Video footage from the Crittercams during these shallow dive bouts indicated the whales were engaged in social, rest and travel behaviours, but no feeding was documented. Dive depth differences between day and night presumably reflect vertically migrating prey, though the prey is concentrated at depths of 300-50 m during the night.

Reproduction: Females become post-reproductive at around 35 years, but may continue to suckle young for up to 15 additional years, suggesting a complex social structure in which older females may give their own or related calves a "reproductive edge" through prolonged suckling. Calving peaks occur in spring and autumn in the Southern Hemisphere, and vary by stock in the Northern Hemisphere (Jefferson et al. 1993).

5. Migration

The species appears to be generally nomadic, with no fixed migrations, but some north-south movements are related to prey movements or incursions of warm water. Inshore-offshore movements are determined by spawning squid (outside the squid season *G. macrorhynchus* is usually found offshore). Some populations are present year-round, such as in Hawaii and the Canary Islands (Carwardine, 1995).

A marked seasonality in the distribution of pilot whales has been observed in at least three areas: off southern California; in the eastern tropical Pacific; and off the coast of Japan. In southern California, the seasonal abundance of pilot whales appears to be correlated with the seasonal abundance of spawning squid. E.g. during years of low squid abundance, fewer pilot whales were sighted near Catalina Island. In both the coastal and pelagic waters of the eastern tropical Pacific, the density of population centres appears to change seasonally in response to major changes in the current structure of the area. In the southern California Bight, the occurrence of short-finned pilot whales was associated with high relief topography. There seems to also be a seasonal distribution with depth: pilot whales were found in significantly shallower water during winter (depth 375 m) than summer (800 m) (Bernard and Reilly, 1999 and refs. therein).

There have been no systematic studies of home range or migration of individuals of this genus. Opportunistic observations in the southern California Bight have indicated that a pod of 20-30 individuals, identified by scars, unusual marks, etc., lived in the area year-round in the 1970's. Following the strong El Niño event in 1982-83, subsequent surveys throughout the 1980s turned up few sightings, and documented the absence of all but one pod of pilot whales near Catalina Island. Shipboard surveys along the entire California coast using line-transect methodology were conducted in 1991 and 1993 within 550 km of shore, documenting an apparent return of this stock. The calculated abundance estimate was 1,004 individuals (Shane, 1995; Bernard and Reilly, 1999 and refs. therein).

6. Threats

Direct catch: The short-finned pilot whale has been exploited for centuries in the western North Pacific. The largest catches have recently occurred off Japan, where small coastal whaling stations and drive fisheries took a few hundred annually (Jefferson et al. 1993). In recent years, the southern form continues to sustain a higher kill than the northern form. In 1982, the drive fishery at Taiji expanded and harpooning of the northern form was resumed off Sanriku and Hokkaido. Between 1982 and 1985, 1,755 whales of the southern form were killed, and 519 of the northern form were taken during this same period. From 1985 to 1989, Japan took a total of 2,326 short-finned pilot whales. The drive fisheries in Japan, as well as the Japanese harpoon fishery continue today. In 1997, Japan recorded a catch of 347 short-finned pilot whales (Olson and Reilly, 2002).

Elsewhere, a small, intermittently active fishery takes around 220 pilot whales per year in the Lesser Antilles in the Caribbean at St. Vincent Island, and there are indications of a small fishery at St. Lucia Island (Bernard and Reilly, 1999 and refs. therein).

Dolar et al. (1994) report on directed fisheries for marine mammals in central and southern Visayas, northern Mindanao and Palawan, Philippines. Hunters at four of the 7 investigated fishing villages took dolphins for bait or human consumption, including short-finned pilot whales. These are taken by hand harpoons or, increasingly, by togglehead harpoon shafts shot from modified, rubber-powered spear guns. Around 800 cetaceans are taken annually by hunters at the sites investigated, mostly during the inter- monsoon period of February-May. Dolphin meat is consumed or sold in local markets and some dolphin skulls are cleaned and sold as curios. Although the Department of Agriculture issued Fisheries Administrative Order No. 185, in December 1992 'banning the taking or catching, selling, purchasing, possessing, transporting and exporting of dolphins', this did not stop dolphin and whale hunting but seems to have decreased the sale of dolphin meat openly in the market.

Incidental catch: There are probably more pilot whales taken incidentally than is presently documented. In US Atlantic waters, pilot whales have been taken in a variety of fisheries, but not exceeding the allowable annual take under US law (Olson and Reilly, 2002). Based on preliminary data, the squid round-haul fishery in southern California waters is estimated to have taken 30 short-finned pilot whales in one year. In the California drift gill net fishery between 1993 and 1995, the mean annual take of short-finned pilot whales was 20 (Bernard and Reilly, 1999 and refs. therein). Since the take in US waters exceeded the allowable limit, a take reduction plan was implemented (Olson and Reilly, 2002). On the other side of the Pacific ocean, an estimated 350-750 *G. macrorhynchus* die annually in passive nets and traps set by the Japanese fishery (Bernard and Reilly, 1999 and refs. therein). The most common human-related cause death categories observed in waters off Puerto Rico and the US and British Virgin Islands were entanglement and accidental captures, followed by animals being shot or speared (Mignucci et al. 1999).

Pollution: There is a wide variation in contaminant loads in short-finned pilot whales. High concentrations of DDT and PCB were found in whales off the Pacific coast of the USA in the mid 70s, while low levels were found in whales from the Antilles and off Japan (Bernard and Reilly, 1999 and refs. therein).

Tourism: The presence of whale watching vessels can potentially cause short-term disturbance in the natural behaviours of several cetacean species and Glen (2003) found a significant difference between the number of vessels around a pod, and *G. macrorhynchus* avoidance behaviour. In the presence of one or two vessels, 28% of sightings involved avoidance behaviours, rising to 62% of sightings in the presence of three or more vessels. Tenerife's resident population of *G. macrorhynchus* is estimated at 350 individuals, and any impacts from whale watching vessels should be minimised until it is shown that they are not detrimental to the status of the population.

7. Remarks

G. macrorhynchus is listed as "Lower risk, conservation dependent" by the IUCN and world-wide only one population of short-finned pilot whales, off northern Japan, is currently considered at risk. Insufficient information is available to accurately evaluate its status elsewhere (Stacey and Baird, 1994).

Investigations are encouraged to ensure that artisanal whale fisheries in the Philippines and the Antilles operate within sustainable limits and do not export products illegally (Dolar et al. 1994). More information is required with respect to abundance, fishery by-catch, home-range, migratory behaviour, pollutant levels and reactions to anthropogenic disturbance such as underwater noise (sonar, ATOC). For recommendations on South American stocks, please see Hucke-Gaete (2000) (see Appendix 1). See also general recommendations on Southeast Asian stocks in Perrin et al. (1996) (see Appendix 2).

This species is not listed by CMS, but inclusion into Appendix II is recommended. Recent results indicate a marked seasonality in the distribution of pilot whales in at least three areas: off southern California; in the eastern tropical Pacific; and off the coast of Japan. Range states concerned are the US, Mexico, Guate-mala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Columbia, Ecuador and Peru, as well as Russia, Japan, North and South Korea and China.

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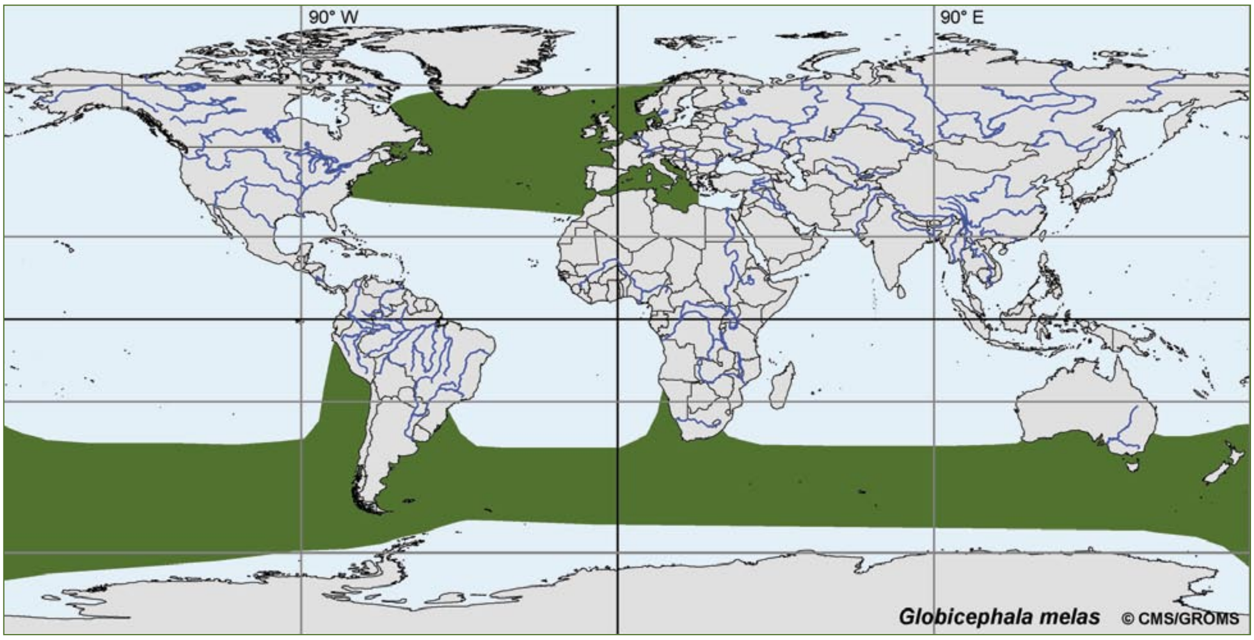
5.13 Globicephala melas (Traill, 1809)

English: Long-finned pilot whale
German: Grindwal
Spanish: Calderón negro
French: Globicéphale noir

Drawing of Globicephala melas © Wurtz-Artescienza.

1. Description

The body in pilot whales is robust, with a thick tail stock. The melon is exaggerated and bulbous and the beak is barely discernible or non-existent. The dorsal fin is wide, broad based, falcate and set well forward on the body. The flippers are long, slender, and sickle-shaped. A faint grey saddle patch may be visible behind the dorsal fin in southern Hemisphere specimens. In the North Atlantic, a thin whitish stripe can be visible in less than half of all adult pilot whales. A pale eye blaze is visible in one fifth of all adult pilot whales, most often in males (Bloch et al. 1993a). A grey midventral line extends to the front into an anchor-shaped chest patch and widens posteriorily to a genital patch. Sexual dimorphism exists with longer



Distribution of Globicephala melas (mod. from Olson and Reilly, 2002; © CMS/GROMS): "antitropical" in cold temperate and subpolar waters of all oceans except the North Pacific (Carwardine, 1995).

flippers and larger flukes in males (Bloch et al. 1993a). The long-finned pilot whale has a narrower skull than the short-finned species (Olson and Reily, 2002).

Long- and short-finned pilot whales (*G. melas* and *G. macrorhynchus*) are difficult to distinguish at sea. However, the species differ, as the name suggests, in flipper length, skull shape and number of teeth. On average, the flippers reach 18-30 % of the body length in long-finned pilot whales, but only 14-19 % in short-finned pilot whales (Bloch et al. 1993a). Adults reach a body length of approx. 6.5 m, males being 1 m larger than adult females (Bloch et al. 1993b; Olson and Reily, 2002).

2. Distribution

G. m. melas: This subspecies ranges in the North Atlantic from Ungava Bay, Disko in western Greenland, 68°N in eastern Greenland, Iceland, the Faroes, and Nordland in Norway, south to North Carolina, the Azores, Madeira, and Mauritania, including the western Mediterranean (Rice, 1998 and refs. therein).

G. m. edwardii (A. Smith, 1834): This subspecies is circumglobal in the Southern Hemisphere, ranging north to São Paulo in Brazil, Cape Province in South Africa, Iles Crozet, Heard Island, the southern coast of Australia, Great Barrier Island in New Zealand, and Arica (19°S) in Chile. Southward it extends at least as far as the Antarctic Convergence 47°S to 62°S and has been recorded near Scott Island (67°S, 179°W) and in the central Pacific sector at 68°S, 120°W (Rice, 1998 and refs. therein).

According to Bloch and Lastein (1993) pilot whales on the western (Newfoundland) and eastern (Faroes) sides of the North Atlantic are distinguishable by minor external morphometric characters and may be geographically isolated from each other. However, Fullard et al. (2000) summarise that despite genetic, morphometric, physiological and observational studies, it remains unclear whether any population substructure exists. They used eight highly polymorphic microsatellite loci to analyse samples from the US East Coast (Cape Cod), West Greenland, the Faeroe Islands and the UK. Although their results indicate that substructure does exist, and is particularly pronounced between West Greenland and other sites, the magnitudes of the various pairwise comparisons do not support a simple isolation-by-distance model. Instead, the patterns of genetic differentiation suggest that population isolation occurs between areas of the ocean which differ in sea surface temperature (Fullard et al. 2000).

3. Population size

There is little information on stocks within the species. Based on surveys in the 1980's there are about 13,000 short-finned pilot whales off eastern Newfoundland. In the north-eastern Atlantic the number of pilot whales inhabiting the area between East Greenland, Iceland, Jan Mayen, Faroe Islands and off the western coasts of the British Islands and Ireland was estimated at around 778,000 by Buckland et al. (1993). Estimates for Antarctic waters are in the order of 200,000 long-finned pilot whales (Bernard and Reilly, 1999 and refs. therein).

4. Biology and Behaviour

Habitat: The typical temperature range for the species is 0-25°C (Martin, 1994) and it may be found in inshore but mostly in offshore waters (Reyes, 1991 and refs. therein). Canadas and Sagarminaga (2000) report on observations in the the Alboran Sea, an important oceanographic transition zone between the Mediterranean and the Atlantic Ocean. Between April and September 1992-1997, the authors sighted 109 pods. Comparison of results for encounter rate and group size with those for other Mediterranean regions, together with site fidelity shown by photo-identification and observations of reproductive behaviour, emphasise the Alboran Sea as being one of the most important areas for this species in the Mediterranean. The average depth at encounters was 849 m ranging from 300 to 1,800 m, and reflecting the distribution of their preferred diet, pelagic cephalopods.

Around the Faroe Islands pilot whales occur all year round with a peak abundance in July-September. New tracking studies show a preference over the border of the continental shelf (Bloch et al. 1993c; Bloch et al. 2003).

Off the coast of Chile, Aguayo et al. (1998) mainly sighted *G. melas* in proximity of the coast, reflecting its preference for the edge of the continental shelf.

Goodall and Macnie (1998) report on sightings in the south-eastern South Pacific, which were clustered from 30-35°S, 72-78°W, the maximum being about 160 nm from shore. In the south-western South Atlantic, sightings clustered in two areas, 34-46°S and off Tierra del Fuego, 52-56°S. Here schools were found up to 1,000 nm from shore. Fifteen sightings were from waters south of the Antarctic Convergence, from December to March. Only one sighting was made south of 44°S in winter, probably due to lack of effort in southern seas during the colder months.

Behaviour: Entire pods can sometimes be seen logging, allowing close approach by boats. The strong blow may be visible in calm weather (Carwardine, 1995).

Schooling: Pilot whales are highly social; they are generally found in pods of 110, but some groups contain up to 1,200 individuals (Zachariassen, 1993; Bloch, 1998). Based on photo-identification and genetic work, pilot whales appear to live in relatively stable pods like those of killer whales, and not in fluid groups characteristic of many smaller dolphins (Jefferson et al. 1993; Canadas and Sagarminaga, 2000). They are social animals, with close matrilineal associations with 60 % females. The pods are often mixed with Atlantic white-sided dolphins (*Lagenorhynchus acutus*) and Bottlenose Dolphins (*Tursiops truncatus*) (Bloch et al. 1993c). When travelling, pods may swim abreast in a line several kilometres across. Short-finned Pilot Whales are often found in the company of Bottlenose Dolphins and other small cetaceans, although they have been known to attack them (Carwardine, 1995). Baraff and Asmutis (1998) describe the association of an individually identified long-finned pilot whale with Atlantic white-sided dolphins over six consecutive years. Pilot whales were also observed in close association with fin, sperm and minke whales, and common, bottlenose, hourglass and possibly dusky dolphins (Goodall and Macnie, 1998).

G. melas is one of the species most often involved in mass strandings e.g. on Cape Cod (Massachusetts, USA) beaches from October to January. Their tight social structure also makes pilot whales vulnerable to herding, and this has been taken advantage of by whalers in drive fisheries off Newfoundland, the Faroe Islands, and elsewhere (Jefferson et al. 1993).

If a whale of extreme social importance or strong filial bond strands due to pathological or navigational problems, others in the pod may strand also and then be unable to remain off the beach once removed due to a secondary social or "caring" response. This social response, however, was used successfully to keep a pod of long-finned pilot whales from repeated strandings by researchers in New Zealand: Because the "distress calls" of the beached young of the pod appeared to evoke a stranding response from the older whales, the younger whales were towed offshore and moored to buoys, an action which lured the older animals back out to sea (Bernard and Reilly, 1999 and refs. therein).

Reproduction: Mating occurs primarily in May-June and again at a lower rate in October in the North Atlantic (Desportes et al. 1993; Martin ans Rothery, 1993). Calving and breeding can apparently occur at any time of the year, but peaks occur in summer in both hemispheres (Jefferson et al. 1993).

Goodall and Macnie (1998) report that young were present in all areas of the south Pacific and south Atlantic, including the sub- Antarctic, where they were seen in January (summer), March and April (autumn) and October (spring), when a birth occurred, and in the Antarctic in summer, with a birth occurring at South Georgia in March (autumn).

Food: Primarily squid eaters, pilot whales will also take small medium-sized gregarious fish, when available (Desportes and Mouritsen, 1993; Jefferson et al. 1993). They feed mostly at night, when dives may last for 18 minutes or more and down to 828 m depth (Carwardine, 1995, Heide-Jørgensen et al. 2003). In the western North Atlantic the main prey is the squid *Illex illecebrosus*, although cod (*Gadus morhua*) or Greenland turbot (*Rheinhardtius hippoglossoides*) may be eaten when squid is not available. Off the Northeast United States, however, Atlantic mackerel (*Scomber scombrus*) is said to be an important prey item, at least during winter and early spring (Abend and Smith, 1997). Olson and Reilly (2002) summarize that the diet in the northwest Atlantic includes cod (*Gadus morhua*), turbot (*Scomber scombris*), herring (*Clupea harengus*), hake (*Merluccios bilinearis*; *Urophysis spec*.) and dogfish (*Squalus acanthias*). The squid (*Todarodes sagittatus*) and species of the genus *Gonatus* are reported prey items of long-finned pilot whales in the eastern North Atlantic. Although squids are the predominant prey around the Faroe Islands, some fish, such as *Argentina silus* and *Micromesistius poutassou,* are taken too. The whales in this region do not appear to select cod, herring or mackerel, although they are periodically abundant (Reyes, 1991 and refs. therein; Desportes and Mouritsen, 1993; Bernhard and Reilly, 1999 and refs. therein). Werth (2000) describes the feeding mechanism in captive juvenile long-finned pilot whales: Depression and retraction of the large, piston-like tongue generate negative intraoral pressures for prey capture and ingestion. Food was normally ingested without grasping by teeth, yet was manipulated with lingual, hyoid, and mandibular movement for realignment; suction was then used to transport prey into the oropharynx.

5. Migration

In the Northwest Atlantic, pilot whales move towards the shelf edge during mid winter through early spring, then move northward along the edge to George's Bank and Nova Scotia, arriving off Newfoundland in summer. The peak of the breeding season is said to be in August in Newfoundland waters, where the whales remain until late autumn. The inshore-offshore movements of pilot whales in the western North Atlantic have been correlated with movements of their preferred prey, squid; similar observations on relative abundance of pilot whales and squid are reported from the Faroe Islands (Reyes, 1991 and ref. therein; Bernard and Reilly, 1999 and refs. therein). According to Carwardine (1995) both subspecies prefer deep water. While some live permanently offshore or inshore, others make inshore (summer and autumn) to offshore (winter and spring) migrations.

Mate (1989) tracked a pilot whale with an Argos satellite-monitored radio tag for 95 days in the western North Atlantic. The whale was located by satellite during movements of at least 7,588 km and sighted from an aircraft several times in the company of other pilot whales. Virtually all deep dives occurred at night, when the whale was likely feeding on squid. Surface resting occurred most often immediately after sunrise on a four- to seven-day cycle.

6. Threats

Direct catch: Drive fisheries for long-finned pilot whales in the Faroe Islands date back to the Norse settlement in the 9th century. Catch statistics exist from the Faroes since 1584, unbroken from 1709-today, showing an annual average catch of 850 pilot whales (range: 0-4,480) with a cyclic variation according to North-Atlantic climatic variations (Bloch and Lastein, 1995; Bloch, 1998). In Greenland, fisheries are minor (Butterworth, 1996).

Incidental catch: Incidental catches are reported from Newfoundland, the Mediterranean and the Atlantic coast of France. In British waters, long-finned pilot whales are accidentally caught in gillnets, purse seines and in trawl fisheries. Very few are reported taken incidentally in fisheries in the southern hemisphere (Reyes, 1991 and refs. therein). However, according to Bernard and Reily (1999 and refs. therein), there are probably more pilot whales taken incidentally than are presently documented. On the east coast of the USA, the foreign Atlantic mackerel fishery was responsible for the take of 141 pilot whales in 1988. This fishery was suspended in early May of that year as a direct result of this abnormally high take. A 1990 workshop to review mortality of cetaceans in passive nets and traps documented an annual kill of 50-100 *G. melas* off the Atlantic coast of France. Furthermore, pilot whales are also known to be taken incidentally in trawl and gillnet fisheries in the western North Atlantic, and in swordfish driftnets in the Mediterranean (Jefferson et al. 1993).

Zerbini and Kotas (1998) report on cetacean-fishery interactions off southern Brazil. The pelagic driftnet fishery is focused on sharks (families Sphyrnidae and Carcharinidae) and incidentally caught species include 15 *Globicephala melas* in 1995 and 1997. Authors conclude that the driftnet fishery may be an important cause of cetacean mortality and that a systematic study should be carried out in order to evaluate the impact of this activity.

Overfishing: Commercial fisheries for squid are widespread in the western North Atlantic. Target species for these fisheries are squid eaten by pilot whales, making these vulnerable to prey depletion.

Pollution: Long-finned pilot whales off the Faroes, France, UK and the eastern US appear to be carrying high levels of DDT and PCB in their tissues. However, those animals examined off the Newfoundland and Tasmanian coasts had very low levels, at least of DDT. Heavy metals such as cadmium and mercury also have been found in pilot whales from the Faroes. Because these contaminants accumulate in tissues over time, older animals and especially adult males tend to have higher concentrations (Borell and Aguilar, 1993; Caurant et al. 1993; Caurant and Amiard-Triquet, 1995). Combinations and levels of these pollutants may one day play a role in stock differentiation (Reyes, 1991 and refs. therein; Bernard and Reilly, 1999 and refs. therein; Frodello et al. 2000; Nielsen et al. 2000).

Weisbrod et al. (2000) characterised organochlorine bioaccumulation in pilot whales collected from strandings in Massachusetts and caught in nets. Whales that stranded together had more similar tissue-levels than animals of the same gender or maturity, reflecting pod-fidelity. The high variation in tissue concentrations among individuals and pods, and the similarity within a stranding group suggest that pilot whale pods are exposed to a large range of pollutant sources, such as through different prey and feeding locations (Desportes et al. 1994).

A different form of pollution has recently been investigated by Rendell and Gordon (1999): The increasing level of man-made noise in the world's oceans may have an effect on acoustically sensitive groups such as cetaceans. The military makes extensive use of underwater sound in order to find targets such as ships and submarines, and some active military sonar systems are known to use very loud sources. However, in part because these systems are classified, the characteristics of such sound sources have rarely been published, and there have been few studies of their effects on cetaceans. Although Rendell and Gordon (1999) could not show any deleterious consequences for the species, recordings of vocalisations indicated short-term vocal responses of long-finned pilot whales to the sound source.

7. Remarks

The only current fishery for long-finned pilot whales is undertaken in the Faroe islands and Greenland. Although this fishery has been actively pursued since the 9th century, catch levels have not shown evidence of depletion of the stock as occurred off Newfoundland. ICES and NAMMCO as well as the IWC, have concluded that with an estimated population size of 778,000 in the eastern North Atlantic and approximately 100,000 around the Faroes (Buckland et al. 1993; NAMMCO, 1997) the Faroese catch will not deplete the population. Pilot whales seem to utilise a larger area around the Faroes (Desportes et al. 1994; Bloch et al. 2003), which also reduces any threat.

Globicephala melas is not listed by the IUCN. The North and Baltic Sea populations have been listed in Appendix II of CMS. However, recent data on movements in the NW and NE Atlantic suggest that these stocks should also be included in App. II of CMS. Range states concerned are the US, Canada, Greenland, Iceland, Norway, Ireland and the UK.

Attention should also be paid to the western North Atlantic population(s), in particular that migrating between US and Canadian waters, formerly depleted by overhunting and now facing increasing incidental mortality in trawl fisheries (Reyes, 1991 and refs. therein).

As noted above, pollution (including noise pollution) by-catch and mass strandings may be a threat to the species and warrant further investigation. Population size and migratory patterns, including home-range sizes are insufficiently known. For recommendations on South American stocks, please see Hucke-Gaete (2000) in Appendix 1.

Please also see a report on the long-finned pilot whale posted on the web by the North Atlantic Marine Mammal Commission: http://www.nammco.no

Kindly reviewed by Dorete Bloch, Museum of Natural History, Thorshavn, Faroe Islands.

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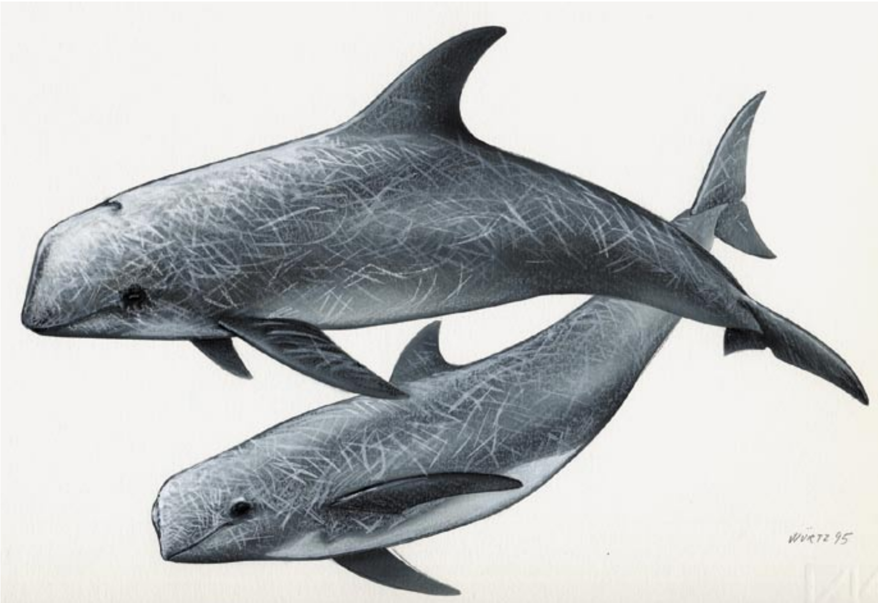
5.14 Grampus griseus (G. Cuvier, 1812)

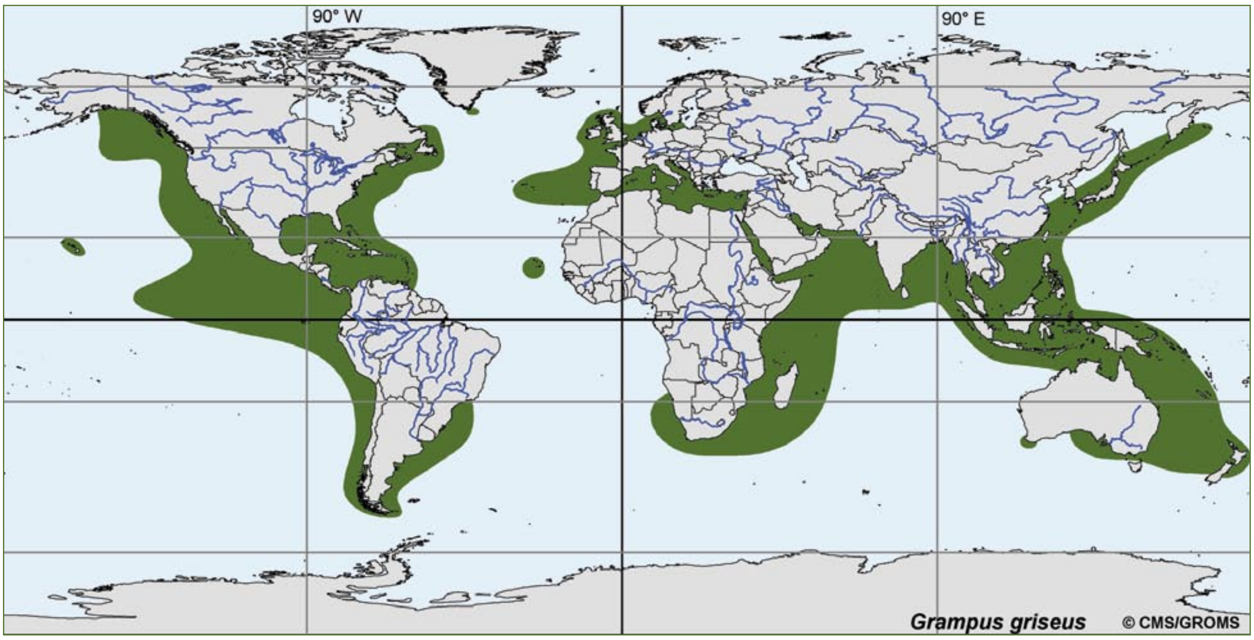
English: Risso's dolphin
German: Rundkopfdelphin
Spanish: Delfín de Risso
French: Dauphin de Risso



Drawing of *Grampus griseus* © Wurtz-Artescienza.

1. Description

Risso's dolphin is the fifth largest of the delphinids. Adults of both sexes reach 4 m in length. Their anterior body is extremely robust, tapering to a relatively narrow tail stock and their dorsal fin is one of the tallest in proportion to body length among any cetacean. The bulbous head has a distinct vertical crease or cleft along the anterior surface of the melon. Colour patterns change dramatically with age. Infants are dorsally grey to brown, then darken to nearly black and lighten while maturing (the dorsal fin remaining dark). In ageing animals, the majority of the dorsal and lateral surfaces become covered with distinctive linear scars.



World-wide distribution of Grampus griseus (mod. From Kruse et al. 1999): tropical and warm temperate waters in both hemispheres; © CMS/GROMS.

Older animals can appear completely white on the dorsal surface (Baird, 2002).

Hybrids between this species and the bottlenose dolphin have been recorded, both in captivity and in the wild (Jefferson et al. 1993).

2. Distribution

This is a widely distributed species, inhabiting deep oceanic and continental slope waters 400-1,000 m deep (Baird, 2002) from the tropics through the temperate regions in both hemispheres (Jefferson et al. 1993). Sighting records indicate this species occurs roughly between 60°N and 60°S latitudes, where surface water temperature are above 10 °C (Kruse et al. 1999). It ranges north to Newfoundland, the Shetland Islands, the North Sea (Weir et al. 2001), the Mediterranean Sea, Ostrov Iturup in the Ostrova Kuril'skiye, Komandorskiye Ostrova, 56°, 146° in the northern Gulf of Alaska, and Stuart Island (50°N) in British Columbia; and south down eastern South America as far as Cabo de Hornos in Chile, to Cape Province in South Africa, Geographe Bay (33°S) in Western Australia, Sydney in New South Wales, North Island in New Zealand, and Valparaiso in Chile (Rice, 1998).

3. Population size

There are very few population estimates in the recent literature: Forney and Barlow (1998) observed that the abundance of Risso's dolphins off California was almost an order of magnitude higher in winter (n = 32,376) than in summer (n = 3,980). Population estimates off Sri Lanka ranged from 5,500 to 13,000 animals (Kruse et al. 1999 and refs. therein). In the eastern Sulu Sea, Dolar (1999) estimated the population size at 950 individuals.

In relative terms, there are several examples of long term changes in abundance and distribution, e.g. in the Southern California Bight (Kruse et al. 1999 and refs. therein). In the late 1950s, Risso's dolphins were rarely encountered in this area, and between 1975 and 1978, they were still considered to be a minor constituent of the cetacean fauna of the Bight, representing only 3 % of the cetaceans observed. Since the El Niño of 1982/83, however, numbers of Risso's dolphins have increased, especially around Santa Catalina Island where they are now considered to be common.

4. Biology and Behaviour

Habitat: Risso's dolphins are pelagic, mostly occurring seaward of the continental slope. They frequent subsurface sea-mounts and escarpments where they are thought to feed on vertically migrant and mesopelagic cephalopods. In Monterey Bay, California, Risso's dolphins are concentrated over areas with steep bottom topography. Currents and upwelling causing local increases in marine productivity may enhance feeding opportunities, resulting in the patchy distribution and local abundance of this species world wide (Kruse et al. 1999 and refs. therein). Davis et al. (1998) and Baumgartner (1997) report that in the Gulf of Mexico, Risso's dolphins were mostly found over deeper bottom depths, concentrating along the upper continental slope, which may reflect squid distribution. According to Carwardine (1995) most records of *Grampus griseus* In Britain and Ireland are within 11 km of the coast. In the US the species is found primarily near the shelf edge.

Behaviour: *G. griseus* are often seen surfacing slowly, although they can be energetic, sometimes breaching or porpoising, and occasionally bowriding (Jefferson et al. 1993).

Reproduction: In the North Atlantic, there appears to be a summer calving peak (Jefferson et al. 1993), but according to Baird (2002) there generally appears to be a peak in calving seasonality in the winter months.

Schooling: Herds tend to be small to moderate in size (1-100 individuals), averaging 30 animals, but groups of up to 4,000 have been reported, presumably in response to abundant food resources. Limited data on subgroup composition obtained from mass strandings and observations of captive animals suggest that cohesive subgroups may be composed of same-sex and similar-age individuals. Risso's dolphins commonly associate with other species of cetaceans such as gray whales, Pacific white-sided dolphins, northern right whale dolphins, Dall's porpoises, sperm whales, short-finned pilot whales, bottlenose dolphins, common dolphins, striped dolphins, spotted dolphins, false killer whales, and pygmy killer whales (Kruse et al. 1999 and refs. therein).

Food: Risso's dolphins feed on crustaceans and cephalopods, but seem to prefer squid. Squid bites may be the cause of some of the scars found on the bodies of these animals (Jefferson et al. 1993).

Kruse et al. (1999) summarise that risso's dolphins prey on a mix of neritic, oceanic, and occasionally bottom dwelling cephalopods. From daily activity patterns observed off Santa Catalina Island, California, Risso's dolphins are presumably mainly nocturnal feeders. Santos et al. (2001) found *Octopus vulgaris* in the stomachs of animals stranded in NW Spain.

Blanco et al. (2003) analysed stomach contents of 13 Risso's dolphins stranded on the western Mediterranean coast between 1987 and 2002 and found only cephalopod remains: 25 species belonging to 13 families were found in the samples, mostly *Argonautidae*, *Ommmastrephidae*, *Histioteuthidae* and *Onychoteuthidae*. Despite the numerical importance and high frequency of small pelagic octopods, mainly *Argonauta argo*, Blanco et al. (2003) assume that greater nutritional content came from of ommastrephids, mainly *O. bartrami* and *T. sagittatus* because of the larger size of some specimens. Prey are mainly oceanic and pelagic species with a muscular mantle. According to the distribution records of prey in the western Mediterranean, Risso's dolphins more frequently inhabit the outer continental slope and shelf break region. The preference for this habitat may be explained by the high marine productivity with enhanced feeding opportunities and this agrees with results from other countries and sightings in the area.

5. Migration

Although *Grampus* is present year-round in most of its range, there may be seasonal onshore—offshore movements in some areas (Carwardine, 1995). *Grampus griseus* seems to be more abundant around northern Scotland in the summer and in the Mediterranean in the winter (e.g. Gannier, 1998; Evans, 1998).

Similar seasonal shifts in abundance have been reported from the Northwest Atlantic, British coastal waters, and the south-east coast of South Africa. Summer "reproductive migrations" (characterised by schools of 20-30 animals with empty stomachs and females carrying large foetuses), and winter "feeding migrations" (characterised by schools of nearly 200 animals with full stomachs and females carrying smaller foetuses) have been observed off Japan. Because some authors maintain that the species is equally abundant in some areas throughout the year, systematic studies of the distribution and abundance of Risso's dolphins in localised areas are required to resolve this conflict (Kruse et al. 1999 and refs. therein).

Water temperature appears to be a factor that affects the distribution of Risso's dolphins, the acceptable temperature range for the species being 7.5°C-35°C (Kruse et al. 1999 and refs. therein). In California, increasing numbers of Risso's dolphin and a shoreward shift in their distribution have been observed during periods of warm water, suggesting that seasonal patterns of distribution and abundance are associated with changing sea surface temperatures (Kruse et al. 1999).

However, despite a significant difference in seasonal abundance, Forney and Barlow (1998) found no significant difference in distribution of Risso's dolphins in Californian waters. In both summer and winter, they were seen most frequently in the Southern California Bight and were also observed off central California. Seasonal movement of Risso's dolphins from California into Oregon and Washington waters in spring and summer has been suggested and there is an indication that Risso's dolphins were also common in offshore waters of northern California. The degree of movement into Mexican waters is unknown (Forney and Barlow, 1998).

6. Threats

Direct catch: In Sri Lanka, Risso's dolphins are apparently the second most commonly taken cetacean in fisheries, providing fish and meat for human consumption and fish bait; stocks there may be adversely affected (Jefferson et al. 1993). An estimated 1,300 Risso's dolphins may be landed annually as a result of this fishery and population estimates in these waters range only from 5,500 to 13,000 animals (Kruse et al. 1999). In Japan, Risso's dolphins are taken periodically for food and fertiliser in set nets and as a limited catch in the small-type whaling industry (Kruse et al. 1999 and refs. therein).

Incidental catch: Although they have never been the basis of a large-scale fishery, Risso's dolphins have been taken periodically as by-catches in other fisheries throughout the world. There are reports from the North Atlantic, the southern Caribbean, the Azores, Peru, and the Solomon Islands. They are also a rare by-catch in the US tuna purse seine industry, and are taken occasionally in coastal gill net and squid seining industries off the US coast, or shot by aggravated fishermen (Kruse et al. 1999 and refs. therein).

Culling: Off Japan, they are killed in the drive fishery (oikomi) in response to competition with commercial fisheries (Kruse et al. 1999 and refs. therein).

Pollution: Accumulation of butyltin compounds, organochloride and DDT levels have been analysed in tissue samples from various specimens (Kruse et al. 1999 and refs. therein). Mercury levels have been reported by Frodello et al. (2000). Increasing levels of plastics and other refuse at sea may pose a threat to wild populations: Necropsies of specimens from Japan revealed that they had eaten foreign materials such as plastic bags, soda cans, and pieces of rope, which may have been fatal (Kruse et al. 1999 and refs. therein).

7. Remarks

This is a circumglobal species which migrates between summering and wintering grounds. Off California, where these movements are best known, they may involve US and Mexican waters. In other areas, the species is insufficiently known with respect to basic biological parameters. Abundance by-catch and behavioural data at sea are needed in order to enable protection of the natural habitat of the species. For South American stocks, see further recommendations in the Hucke-Gaete (2000) report (see Appendix 1).

General recommendations on Southeast Asian stocks can be found in Perrin et al. (1996; see Appendix 2).

The IUCN lists *G. griseus* as "Data Defficient". The North and Baltic Sea populations are included in Apendix II of CMS. However, as described above, populations off the East and West coasts of North America (Range states US, Mexico, Canada) also seem to migrate along the coast, and this is also the case for animals off SE South Africa. It is therefore suggested not to restrict the inclusion into CMS App. II to the populations mentioned, but to include *G. griseus* as a species.

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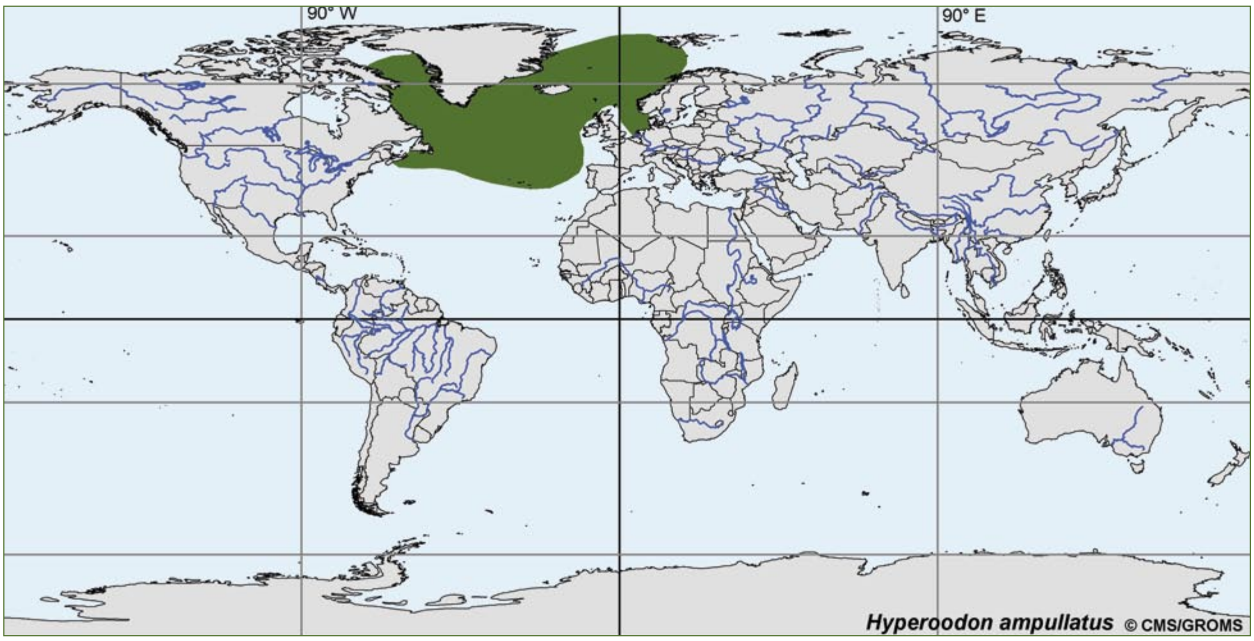
5.15 Hyperoodon ampullatus (Forster, 1770)

English: North Atlantic bottlenose whale
German: Dögling, Entenwal
Spanish: Ballena nariz de botella del Norte
French: Hyperoodon boréal

Drawing of Hyperoodon ampullatus © Wurtz-Artescienza.

1. Description

Bottlenose whales are relatively large beaked whales and reach 6-9 m body length. Their body shape is robust and they have a large, bulb-shaped forehead and short, dolphin-like beak.Their colour is chocolate brown to yellow, being lighter on the flanks and belly. This coloration is believed to be caused by a thin layer of phytoplankton, diatoms. Mature males have a squared-off forehead, which turns white after sexual maturity is reached, whereas in females and immature males it is rounded and brown (Bloch et al. 1996). Males possess a single pair of conical teeth at the tip of the lower jaw, rarely visible in live animals (Gowans, 2002).



Distribution of Hyperoodon ampullatus: North Atlantic Ocean, normally in water deeper than 1,000 m (mod. from Carwardine, 1995; © CMS/GROMS).

2. Distribution

The North Atlantic bottlenose whale is found in the subarctic North Atlantic from Davis Strait, Jan Mayen, west coast of Spitsbergen, and Bjornøya, south to Nova Scotia and the western side of the British Isles (Rice, 1998). Lucas and Hooker (2000) report recent strandings from Sable Island, Nova Scotia and Gowans (2002) includes the Azores into the normal range of the species.

Most if not all past reports of *Hyperoodon ampullatus* in the temperate and subarctic North Pacific seem to have been due to confusion with *Berardius bairdii*, because both species are known colloquially as "bottlenose whales" (Rice, 1998).

There seem to be certain pockets of abundance, for example: around "the Gully", north of Sable Island, Nova Scotia, Canada; in the Arctic Ocean, between Iceland and Jan Mayen, southwest of Svalbard and East off Iceland-North off the Faroes; and in Davis Strait, off northern Labrador, Canada, especially around the entrance to Hudson Strait and Frobisher Bay (Carwardine, 1995). There are no confirmed records from Novaya Zemlya, the Barents Sea or the coast of Finnmarken (Mead, 1989).

North Atlantic bottlenose whales are less common in the extreme southern part of their range (Carwardine, 1995). There are few records east of the Norwegian Sea and from the Mediterranean (Rice, 1998). One specimen was reportedly caught in the North Sea during the period 1938-1972. The species has not been sighted since in the North Sea, but strandings are reported from the coasts of Belgium, Denmark, France and England (Mead, 1989). Strandings have been reported from as far south as Rhode Island (Mead, 1989; Reyes 1991). Kinze et al (1998) report on a recent stranding on the coast of Denmark, Lick and Piatkowski (1998) on a stranding in the Southern Baltic Sea, Van Gompel (1991) on an animal stranded in Belgium and Kastelein and Gerritis (1991) on an animal observed off The Netherlands. One of the most southerly report stems from Duguy (1990) who reports a stranding on the French coast.

Animals in The Gully, off Nova Scotia, seem to be largely or totally distinct from the population seen off northern Labrador: they are smaller and appear to breed at a different time of year (Whitehead et al. 1997).

Earlier, Reyes (1991) found no evidence of the existence of stocks within the species. For statistical consideration Christensen (1976, in Reyes, 1991) assumed that all the bottlenose whales caught east of Greenland belonged to a single population, while Mitchell (1977, in Reyes, 1991) defined Cape Farewell (Greenland) to divide west and east North Atlantic catches.

3. Population size

A study by Christensen and Ugland (1984, in Reyes, 1991) resulted in an estimated initial (pre-whaling) population size of about 90,000 whales, reduced to some 30,000 by 1914. The population size by the mid-1980's was said to be about 54,000, nearly 60% of the initial stock size. Estimates for Icelandic and Faroese waters are 3,142 and 287 whales respectively, although allowance was not made in the surveys for animals not observed because of their long dives (Reyes, 1991). NAMMCO has calculated the population size of this species in the eastern part of the North Atlantic to be around 40,000 individuals (NAMMCO Annual Report 1995).

Whitehead et al. (1997) estimate that approximately 230 *H. ampullatus* use the Gully, a prominent submarine canyon on the edge of the Nova Scotia Shelf throughout the year. Approximately 57% of the population reside in a 20 x 8 km core area at the entrance of the canyon at any time. However, Gowans et al. (2000) analysed data from 11 years of photo-identification records to estimate the population size using mark-recapture techniques. The population estimate for the Gully is much smaller, with only 133 individuals. There was no significant increase or decrease in the population. Sex ratio was roughly 1:1, with equal numbers of sub-adult and mature males.

4. Biology and Behaviour

Habitat: *H. ampullatus* is most common beyond the continental shelf and over submarine canyons, in deep water (>1,000 m deep). It sometimes travels several kilometres into broken ice fields, but it is more common in open water. It is known to strand (Carwardine, 1995; Jefferson et al. 1993). Few whales were caught over the continental shelf off Labrador and in waters less than 1000 m deep off the west coast of Norway. In the surrounding waters of Iceland, the whales were sighted at surface temperatures between -1.3°C and +0.9°C (Reyes, 1991).

Behaviour: The Northern Bottlenose Whale is a curious animal: it will approach stationary boats and seems to be attracted by strange noises, such as those made by ships' generators. This, combined with its habit of staying with wounded companions, made it especially vulnerable to whalers: 65,800 were caught by Norway in the time period 1882-1972 (Reeves et al. 1993, Bloch et al. 1996). These deep-divers can remain submerged for an hour, possibly as long as 2 h.

Reproduction: Northern bottlenose whales have a calving peak in April (Jefferson et al. 1993).

Schooling: Most pods contain at least 4 whales, sometimes with as many as 20, and there is some segregation by age and sex (Mead, 1989, Jefferson et al. 1993).

Food: Although primarily adapted to feeding on squid, these whales also eat fish, sea cucumbers, starfish, and prawns. They apparently do much of their feeding on or near the bottom (Jefferson et al. 1993; Mead, 1989). Hooker and Baird (1999) showed that northern bottlenose whales in a submarine canyon off Nova Scotia exhibit an exceptional diving ability, with dives approximately every 80 min to over 800 m (maximum 1,453 m) depth, and up to 70 min in duration. Sonar traces of non-tagged, diving bottlenose whales in 1996 and 1997 suggest that such deep dives are not unusual. This shows that they may make greater use of deep portions of the water column than any other mammal so far studied. Many of the recorded dives of the tagged animals were to, or close to, the sea floor, consistent with benthic or bathypelagic foraging. Hooker et al. (2001) found a high proportion of the squid *Gonatus steenstrupi* in the stomachs of two bottlenose whales stranded in eastern Canada. They also collected remote biopsy samples from free-ranging bottlenose whales off Nova Scotia and determined fatty acid composition. Overall, the results of these techniques concurred in suggesting that squid of the genus *Gonatus* may form a major part of the diet of bottlenose whales in the Gully (Hooker et al. 2001).

Stomach content analysis by Clarke and Christensen (1980) on a specimen stranded on the Faroe Islands showed that while the cephalopods found included six cold water species which were probably taken in deep water within the vicinity of the Faroes, they also included one species, *Vampyroteuthis infernalis*, which is a warmer water species and probably comes little further north than 40°N. This suggests the whale had been much further south in the Atlantic than the Faroes at 62°N just before its stranding or that the distribution pattern of cephalopods is not that well known. The stomach contents examined in the Faroese show more diversity with 13 species eaten than those from a whale stranded in Denmark (Clarke & Kristensen, 1980) and from whales shot off Labrador and Iceland (Benjaminsen & Christensen, 1980) which contained only one species, *Gonatus fabricii*. For details on beaked whale diet and niche separation see also the account on Mesoplodont whales (see page 154).

5. Migration

Migratory movements are poorly documented, as are stock relations among the animals found in apparently disjunct centres of spring and summer abundance (Reeves et al. 1993). In the eastern part of the range *H. ampullatus* probably moves north in spring and south in autumn; in the west, at least some animals are believed to overwinter at lower latitudes. There may also be some inshore-offshore movements (Carwardine, 1995).

In the western North Atlantic, Bottlenose whales are present during much of the year in The Gully near Sable Island (Nova Scotia) and in the Labrador Sea. Bottlenose whales in The Gully appear to be non-migratory, and this population of a few hundred whales might be vulnerable to the environmental degradation associated with nearby oil and gas production (Reeves et al. 1993). However, Gowans et al. (2000) found that over the summer field season, individuals emigrated from, and re-immigrated into the Gully, spending an average of 20 days within the Gully before leaving. Approximately 34 % of the population was present in the Gully at any time. Individuals of all age and sex classes displayed similar residency patterns although there were annual differences as individuals spent less time in the Gully in 1996 than in 1990 and 1997. Sighting rates were similar in all years with extensive fieldwork, indicating little variability in the number of whales in the Gully each summer.

Mitchell (1977, in Reyes, 1991) suggested that in the western North Atlantic, *H. ampullatus* may forage into the Northeast Channel and the Gulf of Maine in winter months.

A southward migration, better known in the eastern North Atlantic begins in July, when animals are moving south from the Norwegian Sea, and continues to September. The Increase of strandings on the British coasts and on the North Sea coasts probably reflects part of this summer migration, which remains unknown in the northwest Atlantic. There is evidence from the distribution of catches that a northward migration occurs in the eastern North Atlantic in April-July (Reyes, 1991 and refs. therein). Bottlenose whales occur all year round in the Faroes, but with a distinct peak a fortnight around 1 September pointing at a very synchronized southernly migration route (Bloch et al. 1996).

For the Atlantic Frontier, an area of deep water to the north and west of Scotland, bottlenose whale (*Hyperoodon ampullatus*) and Sowerby's beaked whale (*Mesoplodon bidens*) sightings were analysed and the relationship between sightings and oceanographic variables examined. There seem to be two important areas for beaked whales on the Atlantic Frontier: The Shetland-Faroes Channel and an area to the south-west of the Faroes, including the northern end of the Rockall Trough. These areas are linked by a corridor of suitable beaked whale habitat approximately 80 km long and 50 km wide at its narrowest point. Evidence of migratory movements of beaked whales in the north-east Atlantic was obtained from an examination of historical strandings data from the United Kingdom and the Republic of Ireland, and from whaling records from the Faroes, Iceland and the Norwegian Sea. There is strong evidence to suggest that beaked whales, particularly northern bottlenose whales, undertake regular migrations, moving south-west in late summer and autumn and moving north-east in late winter and spring. During movements between the Shetland-Faroes Channel to the area south-west of the Faroes, or vice-versa, the narrow corridor of suitable beaked whale habitat which connects these two areas may form a 'bottleneck' through which the beaked whales must pass. Due to the restricted area of suitable habitat, beaked whales may be particularly vulnerable to anthropogenic im-pacts at this point. In particular, noise pollution, which has the potential to impact a large area simultaneously, in this bottleneck area during migrations may have a disproportionately large impact on beaked whales on the Atlantic Frontier (Mac Leod and Red, 2003).

6. Threats

Direct catch: Northern bottlenose whales have traditionally been the most heavily hunted of the beaked whales. Some hunting has been done by the British and Canadians, but by far the major bottlenose whaling nation was Norway. Early on, they were hunted primarily for oil, but later mainly for animal feed. No hunting has been conducted by Norway since 1973 (Jefferson et al. 1993, Reyes, 1991). The species has been protected since 1977 (Carwardine, 1995).

Mitchell (1977, in Reyes, 1991) considers that the population was severely depleted in both the early and modern whaling periods. At present some are taken in the Faroe Islands, on average 2.2 whales per year in the period 1709-2002. However, there are reports that this limited catch probably does not constitute a significant threat to the species (Reyes, 1991; NAMMCO, 1995).

Incidental catch: None reported (Reyes, 1991).

Pollution: Pollutant levels in this species are usually low (Reyes, 1991 and ref. therein).

Habitat degradation: Whitehead et al. (1997) report that threats to the population in The Gully off Nova Scotia include commercial shipping, fishing and oil and gas developments. One oil and gas discovery of commercial interest, the Primrose Field, lies about 5 km from the core area of this population. The population is vulnerable because of its small size, location at the extreme southern limit of the species' range, and year-round dependence on a small and unique sea area. It is threatened by plans for the development of the oil and gas fields close to the Gully.

Overfishing: There are no major fisheries for squid in the Northeast Atlantic, but future developments could represent some threat for populations as heavily depleted as that of the bottlenose whale.

7. Remarks

The northern bottlenose whale is said to have been twice overexploited by Norwegian hunting, in the periods 1880-1920 and 1938-1973. It was included in the IWC Schedule in 1977 and classified as a provisional Protected Stock with zero catch limits (Reyes, 1991 and refs. therein).

H. ampullatus is categorised as "Low Risk, conservation dependent" by the IUCN. It is listed in appendix II of CMS as well as in Appendix I & II of CITES.

Range States include Canada, Denmark (Faroe Islands), Iceland, Ireland, Norway, United Kingdom, and the United States. The species is protected through general marine mammal legislation in these countries. Norway, Ireland and United Kingdom are Parties to the Convention (Reyes, 1991).

Populations or stocks are not defined; this, together with estimates of present abundance as well as present levels of catches (Faroe Islands), should be the focus of future studies (Reyes, 1991).

Kindly reviewed by Dorete Bloch, Museum of Natural History, Thorshavn, Faroe Islands.

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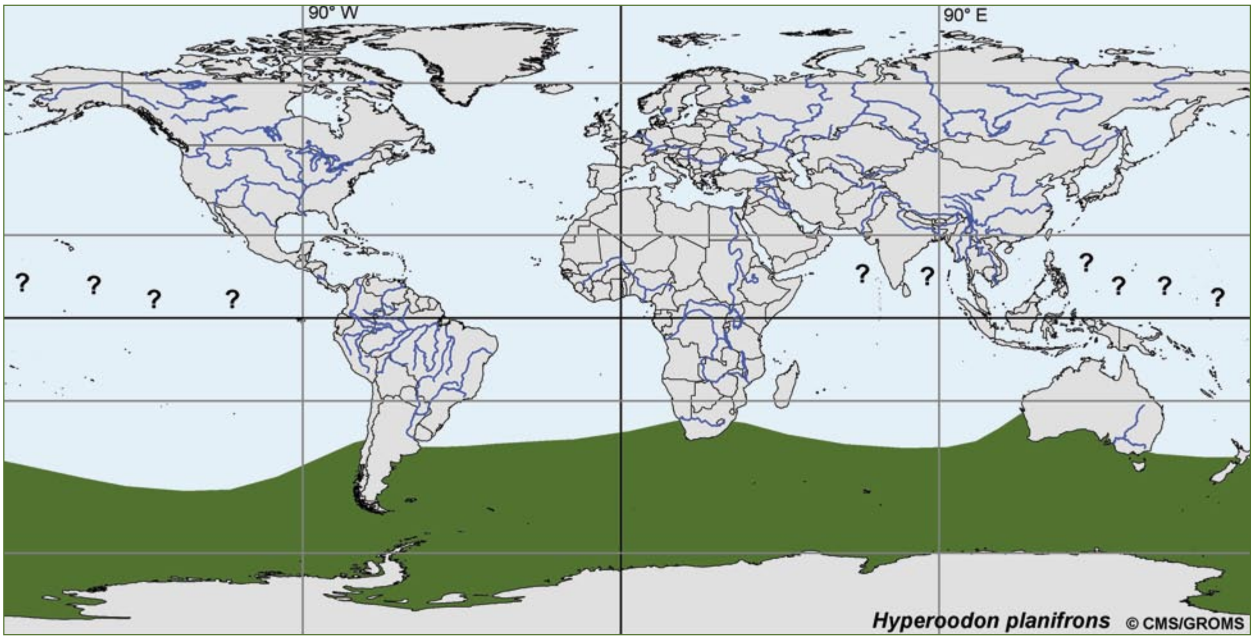
5.16 Hyperoodon planifrons (Flower, 1882)

English: Southern bottlenose whale
German: Südlicher Entenwal
Spanish: Ballena a nariz de botella del sur
French: Hypéroodon austral

Drawing of Hyperoodon planifrons © Wurtz-Artescienza.

1. Description

Bottlenose whales are relatively large beaked whales and reach 6-9 m body length. Their body shape is robust and they have a large, bulb-shaped forehead and short, dolphin-like beak. Their colour is chocolate brown to yellow, being lighter on the flanks and belly. This coloration is believed to be caused by a thin layer of phytoplankton, diatoms. Mature males have a squared-off forehead, whereas in females and immature males it is rounded. Males possess a single pair of conical teeth at the tip of the lower jaw, rarely visible in live animals (Gowans, 2002).



Distribution of Hyperoodon planifrons (mod. from Jefferson et al. 1993; © CMS/GROMS): The species inhabits the cold, deep waters of the southern hemisphere from Antarctica North to at least 29°S (Carwardine, 1995).

2. Distribution

Southern bottlenose whales are thought to have a circumpolar distribution in the Southern Hemisphere, south of 29°S (Mead, 1989; Jefferson et al. 1993) and to cover a wider range than their northern counterparts (Carwardine, 1995). They occur from Rio Grande do Sul in Brazil, Cape Province in South Africa, 31°S in the western Indian Ocean, Dampier Archipelago in Western Australia, Ulladulla in New South Wales, North Island in New Zealand, and Valparaiso in Chile, south to the Antarctic continent (Rice, 1998).

Possible sightings south of Japan, around Hawaii, and along the equator (in the Pacific and Indian Oceans) have not been identified with certainty, but may be discrete populations of this species (Carwardine, 1995; Jefferson et al. 1993).

The records from north-western Australia and from Brazil indicate that *H. planifrons* also occurs in warm temperate waters. It makes plausible the identification of a beaked whale that has been observed in the eastern equatorial Pacific as this species. There have been several reports of a species of *Hyperoodon* in the North Pacific but so far all incidents could be attributed to *Berardius bairdii* (Mead, 1989 and refs. therein). Recent molecular work indicates that there may be more than one species (Dalebout et al. 1998). Pitman et al. (1999) suggested that the tropical bottlenose whale is actually Logman's beaked whale *Indopacetus pacificus*, known hitherto only from skeletal remains.

3. Population size

Mead (1989) reported that there are no population estimates or even rough figures on relative abundance of *Hyperoodon planifrons*. In 1995, Kasamatsu and Joyce (1995) published abundance estimates for south of the Antarctic Convergence in January: 599,300 beaked whales, most of which were southern bottlenose whales.

4. Biology and Behaviour

Habitat: *H. planifrons* is most common beyond the continental shelf and over submarine canyons, in water deeper than 1,000 m. It is rarely found in water less than 200 m deep. In summer, this species is most frequently seen within about 100 km of the Antarctic ice edge, where it appears to be relatively common (Carwardine, 1995). Cockroft et al. (1990) report sightings in the steep thermocline between the Agulhas current and cold Antarctic water masses.

Behaviour: The southern bottlenose whale is poorly known and rarely observed at sea. It lives far from shipping lanes, and has never been heavily exploited, so it has not been as well studied as its northern counterpart. There are few reports of swimming near boats, but this may be due to lack of observation rather than shyness. After long dives, it may remain on the surface for 10 minutes or more, blowing every 30 to 40 seconds. It can stay underwater for at least an hour, but typical dive time is shorter. When swimming fast, especially under stress, it may raise its head clear of water on surfacing. Probably a deep diver, though it does not tend to travel much horizontal distance while submerged (Carwardine, 1995). There is essentially nothing known of the reproductive biology of this species (Jefferson et al. 1993).

Schooling: Pods of less than 10 are most common, but groups of up to 25 have been seen (Jefferson et al. 1993).

Food: Southern bottlenose whales are thought to take primarily squid, but probably they also eat fish (Jefferson et al. 1993; Slip et al. 1995; Clarke and Goodall, 1994). Consumption of food (mostly squid) by all Odontocetes south of the Antarctic convergence was estimated as 14.4 million tonnes with 67 % of the total consumed by beaked whales. Odontocetes, especially southern bottlenose whales, are suggested to have a much greater role in the Antarctic ecosystem than has previously been considered (Kasamatsu and Joyce, 1995). For details on beaked whale diet and niche separation see also the account on Mesoplodont whales (see page 154).

5. Migration

Southern bottlenose whales apparently migrate, and are found in Antarctic waters during the summer. Like other beaked whales, they are deep-water oceanic animals (Jefferson et al. 1993). Kasamatsu and Joyce (1995) investigated the spatial distribution of various cetacean species during mid-summer in Antarctic waters and found different peaks of occurrence for each species by latitude, suggesting possible segregation. Killer whales occur mainly in the very southernmost areas, sperm whales in the southern half of the study area, whereas beaked whales (mostly southern bottlenose whales *Hyperoodon planifrons*) ranged over a wide area.

Sekiguchi et al. (1993) investigated the stomach contents of 2 southern bottlenose whales, a male caught off the east coast, and a female stranded alive on the west coast of South Africa, respectively. Both stomachs contained only remains of oceanic squid species, with four Antarctic and 4 subantarctic squid species present. Sightings of southern bottlenose whales off Durban between February and October showed a strong seasonality with peaks in February and October. The beaks of Antarctic and subantarctic squids in the stomachs, plus the presence of cold water skin diatoms *Bennettella* (= *Cocconeis*) *ceticola* on the male, suggest that the animals had arrived comparatively recently in South African waters from higher latitudes.

6. Threats

Although never taken commercially, some southern bottlenose whales have been killed during whaling for research purposes. Recently, several of this species have been recorded as accidental victims of driftnet fishing in the Tasman Sea. Numbers taken annually are not known, however (Jefferson et al. 1993).

7. Remarks

There is very little information about this species, its biology, abundance, by-catch rates and migratory patterns. More research is clearly needed. *Hyperoodon planifrons* also occurs in southern South America. Recommendations iterated by the scientific committee of CMS for small cetaceans in that area (Hucke-Gaete, 2000) also apply (see Appendix 1). For recommendations on south-east Asian stocks, see Perrin et al. (1996) in Appendix 2.

Both *Hyperoodon* species are listed in Appendix I & II of CITES. *H. planifrons* is categorised as "Low Risk, conservation dependent" by the IUCN. It is not listed by CMS. However, listing by CMS should be considered, based on the fact that the animals seem to undergo migrations between the coasts of various range states and the open ocean.

Potential range states include Chile, Argentina, the United Kingdom (Falklands and South Georgia), Norway (Bouvet Island), the Republic of South Africa, France (Kerguélen Islands), Australia, and New Zealand.

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5.17 Indopacetus pacificus (Longman, 1926)

English: Indo-Pacific whale, Longman's beaked whale
German: Pazifischer Schnabelwal
Spanish: Zifio de Longman
French: Baleine a bec de Longman

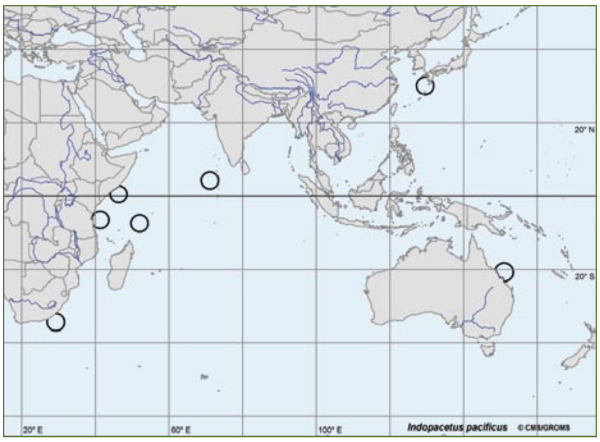
1. Description

This is one of the least known cetaceans, whose existence was first derived from only two skulls. A total of seven specimens are now known (Dalebout et al. 2003). While Pitman (2002) states that the species has never been identified in the flesh, dead or alive, there is a recent report of Yamada (2002) of a dead stranding of a whole specimen in Japan (see also "selected web-sites").

The skull is large for a beaked whale, suggesting an animal around 7 m long. There have been several possible sightings. In 1980, 2 light grey whales were seen by experienced observers near the Seychelles, in the Indian Ocean: one was estimated at 7.5 m and the other at 4.6 m; both had elongated beaks and broad flukes with straight trailing edges (Carwardine, 1995).

2. Distribution

Originally described as a species of *Mesoplodon*, this distinctive but poorly known whale has erroneously been thought to be a race of *Mesoplodon mirus* or a synonym of *Hyperoodon planifrons* (Rice, 1998).



Distribution of Indopacetus pacificus: possibly deep tropical waters of the Indian and Pacific Oceans (mod. From Carwardine, 1995; Mead, 1989; Yamada, 2002; Dalebout, pers. comm.; © CMS/GROMS).

Longman's beaked whale is known from the skulls of two animals which stranded at Danane (01°50'N, 45°03'E), Somalia, in 1955, and at Mackay (21°10'S, 149°10'E), Queensland, Australia, in 1882. (The large unidentified "tropical bottlenose whales" observed in the Indian and Pacific oceans belong to this species; Dalebout, 2003; Rice, 1998). There are new specimens from Kenya, from the Indian Ocean coast of South Africa, and from the Maldives, all positively identified on the basis of morphological characteristics and DNA analyses (M Dalebout, pers. comm.). Balance and Pitman (1998) believe to have seen three *I. pacificus* in the pelagic Western Indian Tropical Ocean.

A specimen first observed in 2002 near Kagoshima, Japan, later stranded. The widely separate locations suggest an extensive range in both the Indian and Pacific Oceans. Based on knowledge of other beaked whales, and the fact that it is rarely seen, it is thought to live in deep, pelagic waters (Carwardine, 1995; Mead, 1989).

Pitman et al. (1999) summarise that about all that is currently known about *I. pacificus* is that it is large, occurs in tropical waters of the western Indian and western Pacific oceans, and has apical teeth. Two explanations for how so large a marine mammal has almost completely escaped the attention of zoologists for so long are proposed: 1) Tropical waters are often adjacent to land masses where there are few if any cetologists and in waters where up until recently little or no pelagic survey work has been conducted. Furthermore, the tropical bottlenose whale is quite a rare species. 2) *I. pacificus* is a large beaked whale of unknown physical description that has for decades been known (or at least suspected) to inhabit the tropical Indo Pacific. Because of a strong physical resemblance, it has, over the years, been repeatedly mis-identified as *Hyperoodon* spec. or *Mesoplodon* spec.

3. Population size
No entries.

4. Biology and Behaviour
No entries.

5. Migration
No entries.

6. Threats
No entries.

7. Remarks
Longman's beaked whale is listed by the IUCN as "Data Deficient" and is not listed by CMS. More information is clearly needed.

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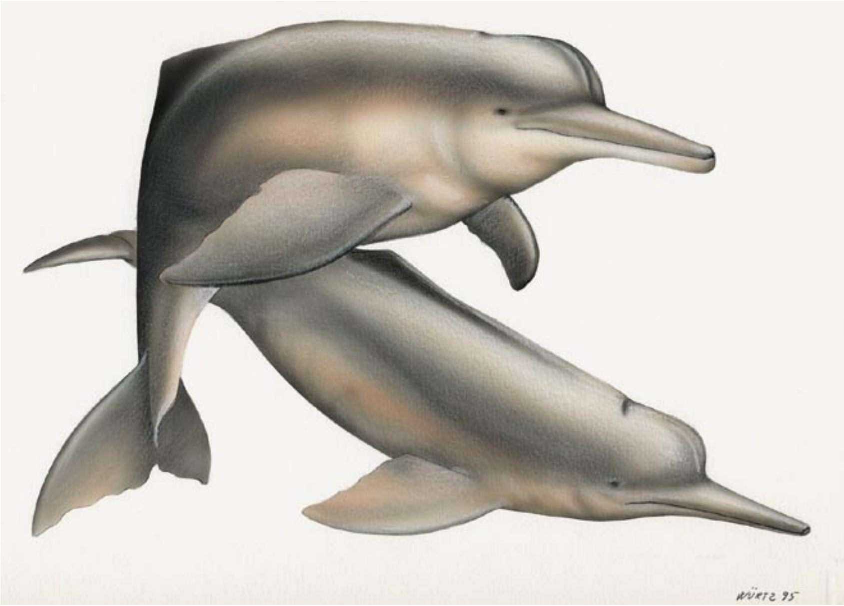
5.18 Inia geoffrensis (de Blainville, 1817)

English: Amazon river dolphin, Boto, Inia
German: Amazonas-Delphin
Spanish: Bufeo
French: Dauphin de l'Amazon



Drawing of Inia geoffrensis © Wurtz-Artescienza.

1. Description

The boto is the largest of the river dolphins. Males reach a maximum body length of 255 cm and a mass of 185 kg, the smaller females reach 215 cm and 150 kg. The body is corpulent and heavy but extremely flexible: the head can be moved in all directions. The flukes are broad and triangular, the dorsal fin is low, keel-shaped long, extending from the midbody to the caudal peduncle. The flippers are large, broad and paddle-like. Whereas swimming speed is not very high, botos are capable of manoeuvring very well between trees in the flooded forest. The rostrum and mandible are long and robust and the melon is small and flaccid. Its shape can be muscularly controlled. Whereas young animals are dark grey, older botos are completely pink or blotched pink and may have a darker back (da Silva, 2002).

Map showing the general distribution of Inia geoffrensis on the Amazon-Orinoco river systems. (mod. from da Silva, 2002; © CMS/GROMS).

2. Distribution

The boto has a very wide distribution and can be found almost everywhere it can physically reach without venturing into marine waters (da Silva, 2002). There are three morphologically distinguishable populations, which are best recognised at the subspecific level (Rice, 1998):

I. g. humboldtiana (Pilleri and Gihr, 1978): ranges in the Orinoco River system, including the Apure and Meta rivers, upstream as far as the rapids at Puerto Ayacucho (Rice, 1998). Contact between this race and the next is restricted, at least during low water, by waterfalls on the upper Rio Negro, by the rapids on the Orinoco river between Samariapo and Puerto Ayacucho, and by the Casiquiare Canal itself (da Silva and Martin, 2000).

I. g. geoffrensis: can be found throughout most of the Amazon River and its tributary rivers (below an elevation of about 100 m), including the Tocantins, the Araguaia, the lower Xingu up to the rapids at Altamira, the lower Tapajós up to the rapids at Sao Luis, the Madeira as far as the rapids at Porto Velho, the Purús, the Juruá, the Ica, the Japura, the Branco, and up the Negro through the Canal Casiquiare into the headwaters of the Orinoco, from whence in ranges as far downstream as San Fernando de Atabapo, including its tributary the Guaviare (Rice, 1998).

I. g. boliviensis (d'Orbigny, 1834): occurs in the upper Rio Madeira drainage in Bolivia, where it is confined to the Rio Mamoré and its main branch the Rio Iténez (= Rio Guaporé), including lower reaches of their larger tributaries (at an elevation of 100-300 m). There are no credible reports from the Rio Beni or any of its tributaries above Riberalta. This subspecies appears to be isolated from the previous one by 400 km of rapids from Porto Velho on the Rio Madeira in Brazil upstream to Riberalta on the Rio Beni in Bolivia. However, Inias of undetermined subspecies live in the Rio Abuna and its tributary the Rio Negro, which enters the Madeira/Beni an the border between Brazil and Bolivia (Rice, 1998 and references therein). Botos in the Beni system may, in fact, constitute a separate species (da Silva 1994) although, at present, a single species is recognised. The IWC sub-committee (IWC, 2000) recognised that this was still an unreconciled issue and awaits the publication of the genetic work.

Banguera-Hinestroza et al. (2002) collected 96 DNA samples from specimens in the Orinoco basin (four rivers), the Putumayo River, a tributary of the Colombian Amazon and the Mamoré, and the Tijamuchy and Ipurupuru rivers in the Bolivian Amazon. From mitochondrial DNA and mitochondrial cytochrome b gene analysis, a subdivision of the *Inia* genus was proposed into at least two evolutionarily signifcant units: one conned to the Bolivian river basin and the other widely distributed across the Amazon and Orinoco basins.

3. Population size

The boto is the most common river dolphin and population densities appear to be relatively high throughout much of its range (IWC, 2000). Its current distribution and abundance apparently do not differ from the past, although relative abundance and density are highly seasonal and appear to vary among rivers (da Silva, 2002). Overall population size, however, is unknown and precise data on trends are insufficient for any of the three subspecies. However, human population growth in the upper reaches of the Mete and other rivers in Colombia might have led to declines of dolphin populations (IWC, 2002).

Differences in density exist between different river systems. Surveys in a 1,200 km section of the Amazon River between Manaus and Santo Antonio de Ica yielded estimates averaging 332 dolphins (Best and da Silva, 1989). Pilleri and Gihr (1977) report an average of one dolphin per 4 km over 130 km on Rio Ichilo, one per 0.9 km on Rio Ipurupuru, and one per 1.0 km on Rio Ibare. From boat survey data Best and da Silva (1989) found an average density of 0.22 *Inia* per km. Vidal et al. (1997) conducted a boat survey in June 1993 to estimate Inia abundance along ca. 120 km of the Amazon River bordering Colombia, Peru, and Brazil. Overall, the mean group size for *Inia* was 2.9 individuals. *Inia* density was highest in tributaries with 4.8 dolphin/km, followed by areas around islands 2.7 dolphin/km and along main banks 2.0 dolphin/km. These are among the highest densities measured to date for any cetacean.

In Bolivia, Aliaga-Rossel (2002) counted 208 bufeos in the Tijamuchi River, with an average encounter rate of 1.12 dolphins per linear km in 1998-99. Dolphins were seen most frequently during low and falling water (56 % of total observations) and least often during high waters (22 % of total observations).

Da Silva and Martin (2000) summarised population data throughout the range, but the authors point out that differences in survey methodology, river morphology and hydrology make any meaningful comparisons between the numerous studies extremely difficult. Nevertheless they also note that density estimates for a 120 km section of the Colombian Amazon are among the highest for any cetacean.

4. Biology and Behaviour

Habitat: Amazon river dolphins are exclusively freshwater. In the Orinoco and Amazon basins, the species is found in a variety of riverine habitat types, including rivers, small channels and lakes, excepting the estuaries and strong rapids and waterfalls. Concentrations occur mainly at the mouth of rivers, below rapids and smaller channels running parallel to the main river. During the high-water season dolphins may utilize both the flooded forest and grasslands, throughout most of Amazon River and its tributary rivers (Reyes, 1991).

Schooling: Although rarely seen in groups of four or more, *Inia* is most often observed as a solitary individual. Loose aggregations have been observed at feeding areas. Most groups of two are apparently mothers and calves. In the survey done by Magnusson et al. (1980), from Manaus to Tefé 81% of the sightings were of a single individual and only 3% of sightings were of four or more animals. Of 407 sightings made from Manaus to Tabatinga, 69% were of one animal and 3% were of four or more. In surveys from Leticia, 58% of sightings were of one animal while 14% were of four or more (Best and da Silva, 1989). Although more often a solitary feeder, *Inia* sometimes form loose groups that fish in a coordinated fashion to herd and attack shoals. These groups may also include the tucuxi (*Sotalia fluviatilis*) and the giant otter (*Pteronura brasiliensis*). Similar group relationships can develop with man in his fishing canoe. Fishermen, on their part, use dolphins to localise shoals of fish and the dolphins use the human fishing operation as a means of disrupting the shoal to their advantage (Best and da Silva, 1989).

Food: *Inias* may frequent shallow waters primarily for feeding (Best and da Silva, l989). About 50 species of fish have been reported as the food of Amazon river dolphins in the central Amazon. Sciaenids, cichlids and characins are the preferred prey; some of them are of commercial value (Best and da Silva, l989).

Reproduction: Calving occurs during the months of May, June, and July, coincident with peak river levels and their initial decline at the start of the dry season. This seasonality means that high energy demands near term and during early lactation are met by increased availability of fish driven from inundated forests by falling water levels. Gestation lasts 10-11 months (Best and da Silva, 1989).

5. Migration

Seasonal migrations seem to represent slight extensions of more or less stable home ranges. Some of these migrations, mostly during flood seasons, are known to cross international boundaries: in the Casiquiare Canal and Upper Rio Negro (Venezuela, Colombia and Brazil); in the Rio Madeira-Guapore system (Brazil and Bolivia); in the Takatu River (Brazil and Guyana) and at Leticia (Peru, Colombia and Brazil) (Best and da Silva, 1989).

The use of territories or home-ranges has been frequently implied (Pilleri and Gihr, 1977). Magnusson et al. (1980), however, found a random distribution along the Solimoes river. If home-ranges exist, they are large and overlapping and not centred around resources. Tagging studies by Best and da Silva (1989) show that individuals may remain in the same area for over a year, but area extent is not known.

Seasonal variation in distribution is being investigated at one site in the central Amazon of Brazil (Da Silva and Martin, 2000). Preliminary results show that most animals generally move only a few tens of kilometres between high and low water seasons. Of more than 160 marked animals, however three had been resighted more than 100 km from the tag site.

In the central Amazon, large changes in water levels affect the local distribution of botos. A 10-15 m increase in water level during the wet season leads to the inundation of large areas of forest. Da Silva and Martin (2000) noted that botos move out of the main river into channels and small lakes, and then into the forest itself, as the water rises.

6. Threats

Direct Catch: Parts of stranded or incidentally caught dolphins may be sold as love charms. In the Beni district, Bolivia, hunting with rifles and nets was previously reported (Pilleri, 1969; Pilleri and Gihr, 1977). Da Silva and Best (1996) conducted interviews with fishermen in boats, in the fishmarket and in the shops supposedly selling dolphin products in an attempt to quantify the overall incidental kill attributed to commercial fisheries operations. The results showed that in the Central Amazon dolphin catches are incidental and only a very small number of these carcasses are used for commercial purposes. In the Colombian Amazon some fishermen have killed *Inia* (including harpooning, shooting and deliberate poisoning) to deter gear interactions. In the Orinoco system and Peruvian Amazon there are also reports of some deliberate killings apparently due to interactions with fisheries (IWC, 2000).

Incidental catches: The main causes of man-made mortality of dolphins in Bolivia were identified as collisions with outboard motors and entanglement in fish-ing nets (Aliaga-Rossel, 2002). By-catch is also reported in the Amazon and Orinoco Rivers, but there are no estimates of the magnitude of these catches. However, fish landings have increased several fold in some areas, representing an increase in fishing effort. A major reason for this increase was the introduction of nylon gillnets in the 1960s. Lampara seine nets, fixed and drift gillnets are responsible for the majority of dolphin deaths. A yet unknown number of dolphins are killed by explosions during illegal fishing operations (Best and da Silva, 1989). In general, incidental mortalities of this species appear to be seasonal and patchily distributed throughout the range. There are no estimates of total incidental mortality, and all accounts are anecdotal. The Scientific Committee of the IWC (2000) agreed that, in the absence of any information on total numbers taken or total population size, it was impossible to assess the significance of this source of mortality. The sub-committee recognised that it would be extremely difficult to obtain reliable estimates of incidental mortality because of the small-scale nature of the fisheries involved. A more sensible approach to the issue might be, in the first instance, to try to determine the scale of incidental mortalities in different types of fishing gear in different regions (IWC, 2000).

Deliberate killing: Amazon river dolphins have learned to take advantage of some fishing activities. They may tear fish from nets (in particular from lampara seine nets) causing considerable loss of fish catch and damage to fishing gear. Also, these dolphins congregate to eat fish stunned by dynamite used illegally by some fishermen. In both instances, fishermen may decide to kill the dolphins. Best and da Silva (1989) mention that at least two reports of harpooned dolphins exist, probably due to this interference with fishing operations.

Overfishing: According to da Silva and Best (1996) the use of nylon gill nets in the Amazon fishery is widely spread throughout the whole region, and with increasing fisheries pressure the potential for dolphin/fisheries interactions is much greater. Competition between man and dolphin for commercial fish, however, is still minimal in the Central Amazon. Dietary analysis has shown that only 43% of 53 identified prey species are of commercial value and that the dolphins generally prey on size-classes of fish below those of commercial interest.

Habitat degradation: Human populations are expanding rapidly in many areas of the boto´s range, especially in Colombia and Brazil. Such population increases result in increased agriculture, deforestation, cattle ranching and the establishment of plantations (IWC, 2000). Deforestation in flood plains for agriculture and the timber industry affects the hydrological cycle and the riverine ecosystem as a whole. One of the major effects of deforestation is the reduction of fish productivity, and hence reduction of food supply for river dolphins and other aquatic animals. Hydroelectric development is at present not a great threat, but several dams are projected for the next few years in the river systems of both Brazil and Venezuela (Best and da Silva, 1989, IWC, 2000). Dams may prevent migra-tions, breaking the populations into very small units with insufficient genetic variability, and reduce food supply (Ralls, 1989, in Reyes, 1991). Strandings in the Formosa River have been reported as resulting from changes in the water level produced by the deviation of waters for irrigation (Best and da Silva, 1989). Furthermore, the water areas behind dams provide an impoverished environment for *Inia*, with lower oxygen concentrations, lower pH levels and fewer fish (IWC, 2000).

Recently (IWC, 2000) oil exploration and production were also identified as a potential threat to *Inia*. In Colombia there had been many oil spills in recent years as a result of the ongoing guerilla war in the upland regions. Some of these had been very extensive, and represented a potential threat that has not yet been quantified. Anecdotal accounts of a decline in numbers were reported in Ecuador. These reported declines were linked to oil spills in the region, though the sub-committee noted that fluctuations in numbers would also be expected due to water level fluctuations.

Pollution: According to Reyes (1991), large quantities of pesticides are being used increasingly in agriculture in the Amazon and Orinoco Basins. Pollution by heavy metals in the Amazon comes from gold mining and associated indiscriminate use of mercury. Effluents from pulp mills are also a potential source of pollution (Best and da Silva, 1989). However, Rosas and Lethi (1996) report that the mercury concentration (176 ng/ml) found in the milk of a lactating *Inia* caught in the Amazon River near Manaus, Brazil was very close to the minimum level of methylmercury toxicity for non-pregnant human adults. This suggests that at least in this part of the river system, contamination is low.

7. Remarks

Inia geoffrensis is categorised as "vulnerable" by the IUCN (A1 cd). This is based on an observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) a decline in area of occupancy, extent of occurrence and/or quality of habitat, and actual or potential levels of exploitation. Seasonal migration in this species is known to involve river systems shared by Brazil, Bolivia, Ecuador, Colombia, Guyana and Venezuela, at least, and the species is also listed in Appendix II of CMS. Brazil, Bolivia and Ecuador are considering to join the CMS (W. Perrin, pers. comm.).

According to a recent evaluation by the Scientific Committee of the IWC (2000), populations of the boto appear to be large and, at present, there is little or no evidence of any decrease in numbers or range. The subcommittee noted the increasing human pressures on the region, and recognised that future anthropogenic effects are to be expected, with declines in range and population fragmentation the most likely consequences. The Asian river dolphins provide a model for the possible effects of increased human populations and dam construction. The subcommittee therefore agreed that there is a need for appropriate monitoring schemes and formulated its recommendations accordingly.

The IWC sub-committee (IWC, 2000) recommended:

- that work on stock structure of *Inia* be conducted and existing studies should be brought to publication as soon as possible,

- that a registry of the distribution of this species should be established, recording in which waterways botos are present, and that the locations of all existing and proposed dams and other large-scale engineering works should be included. Information on other potential threats, such as the scale of fishing operations and the locations of oil pipelines might also usefully be included where practicable,

- that for each population, research should be directed towards detecting trends in abundance or any diminution of range, and identifying causes of any declines. Trends in abundance should be documented by making repeatable, statistically rigorous estimates of density in a range of regions and habitats.

The most significant anthropogenic impact on this species at present appears to be mortalities in fishing operations. These are either entirely incidental (entanglement) or to a greater or lesser extent deliberate, as fishermen are reportedly poisoning botos with baited fish, to limit net depredation, and also shooting and otherwise killing animals found in or near to nets. The sub-committee recommends that information should be collected to allow evaluation of the relative levels of mortality, both indirect and direct, associated with different fishing methods (IWC, 2000).

According to Vidal (1993), the management of renewable natural resources in developing countries has been hampered by a mix of socioeconomic and political difficulties that in turn have resulted in insufficient scientific knowledge, limited environmental awareness and education, and limited commitment to conservation. Aquatic mammals provide good examples. Because many aquatic mammal populations are shared by Latin American countries, international co-operation is critical to ensuring their long-term conservation.

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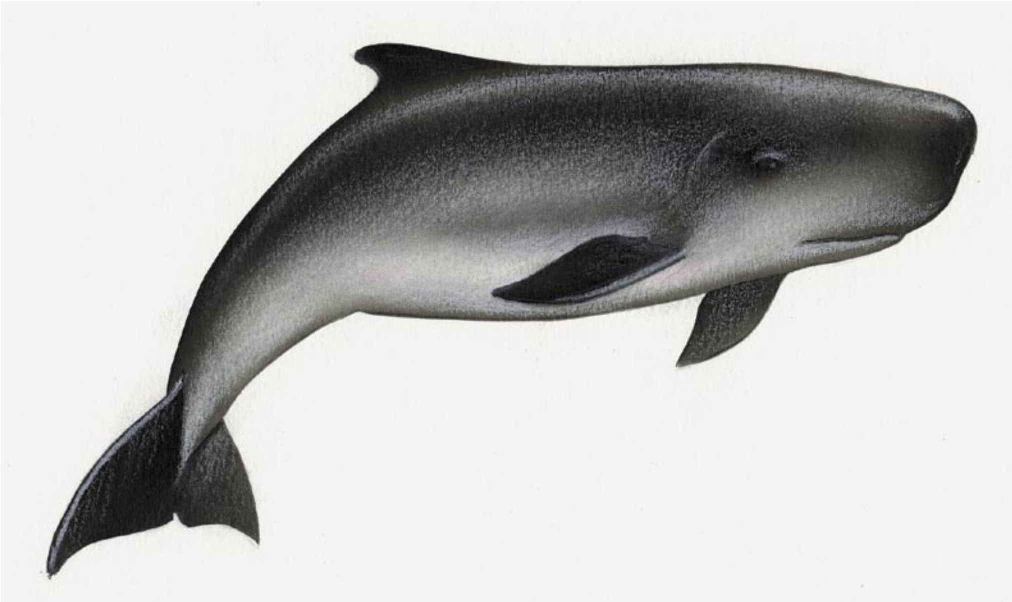
5.19 Kogia breviceps (de Blainville, 1838)

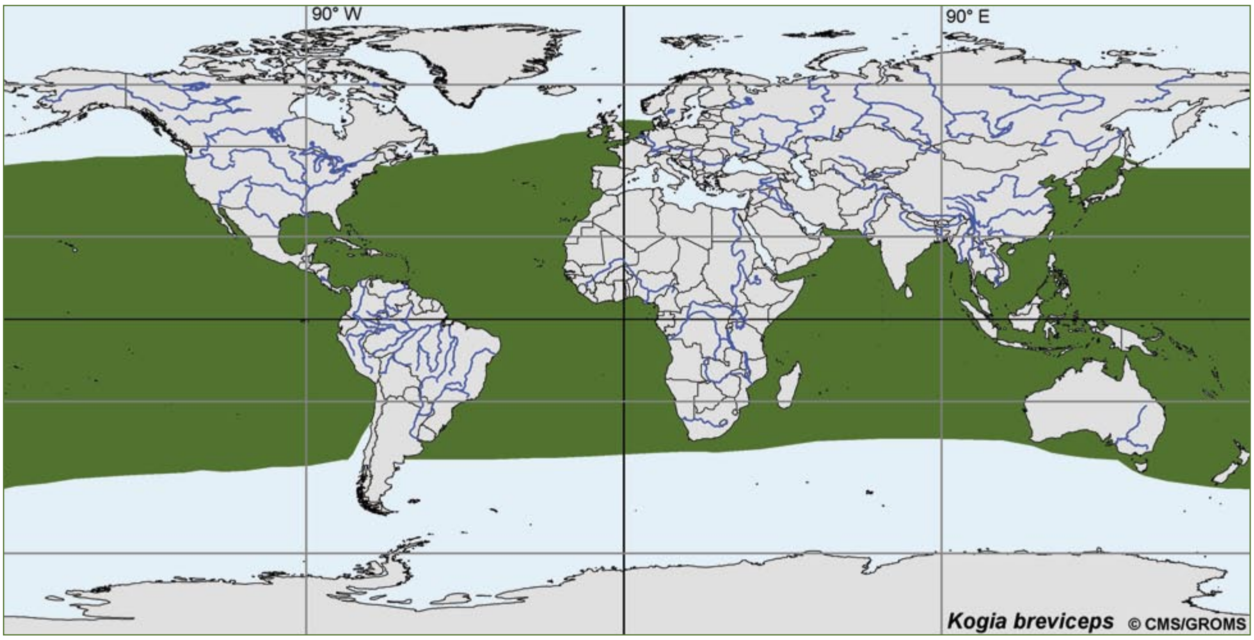
English: Pygmy sperm whale
German: Zwergpottwal
Spanish: Cachalote pigmeo
French: Cachalot pygmée



Drawing of Kogia breviceps © Wurtz-Artescienza.

1. Description

Kogia spp. are porpoiselike, and robust, with a distinctive underslung jaw, not unlike sharks. They have the shortest rostrum among cetaceans and the skull is markedly asymmetrical. Pygmy sperm whales reach a maximum size of about 3.8 m total length and a body mass of 450 kg. Colouration in adults is dark blueish grey to blackish brown on the back with a light venter. On the side of the head, between the eye and the flipper, there is often a crescent-shaped, light-coloured mark referred to as a "false gill" (McAlpine, 2002).



Distribution of Kogia breviceps: deep temperate, subtropical, and tropical waters beyond the continental shelf (mod. from Jefferson et al. 1993; © CMS/GROMS).

2. Distribution

The Pygmy sperm whale is evidently an oceanic species that lives mostly beyond the edge of the continental shelf in tropical and temperate waters around the world. It ranges north to Nova Scotia, the Azores, the Netherlands, Miyagi on the east coast of Honshu, Hawaii, and northern Washington State. It ranges south to Uruguay, Cape Province, the Tasman Sea, Islas Juan Fernández, and Arica, Chile (Rice, 1998). It appears to be relatively common off the southeastern coast of the USA and around southern Africa, southeastern Australia, and New Zealand (Carwardine, 1995). A total of 28 strandings were reported for Europe until 1991 (Duguy, 1994). Recent strandings were recorded in Hawaii (Mazzuca et al. 1999), Sable Island, Nova Scotia (Zoe and Hooker, 2000), Spain (Abollo et al. 1998), Veracruz, Mexico (Delgado et al. 1998), Chile (Sanino and Yanez, 1997), France (Duguy, 1991), Micronesia (Eldredge, 1991) and South Australia (Kemper, 1991). There was a sighting off Vietnam (Smith et al. 1997). It is unknown whether the populations are isolated (Carwardine, 1995). However, Martin and Heyning (1999) reported the cyamid amphipod species *Isocyamus kogiae* Sedlak-Weinstein (1992) for the first time from a *K. breviceps* stranded in southern California, extending the known range of the amphipod from Moreton Island, Queensland, Austra-lia, to the northeastern Pacific. This ectoparasite suggests that pigmy sperm whales from both sides of the Pacific are not isolated from each other.

Kogia breviceps is poorly known, though a lack of records of live animals may be due to inconspicuous behaviour rather than rarity. Most information stems from strandings (especially females with calves), which may give an inaccurate picture of the actual distribution at sea (Carwardine, 1995).

3. Population size

In areas where they frequently strand, members of the genus *Kogia* are considered to be one of the most common species to come ashore. While many large males strand, many *Kogia* strandings also consist of a female and small calf or a female that has given birth only recently. However, as with *K. sima*, there are no real estimates of abundance (Caldwell and Caldwell, 1989).

4. Biology and Behaviour

Habitat: *K. breviceps* seems to prefer warmer waters: there are records from nearly all temperate, subtropical, and tropical seas. It is rarely seen: it tends to live a long distance from shore and has inconspicuous habits. It is often confused with the Dwarf Sperm Whale (*K. sima*), which was not recognised as a separate species until 1966. With so few field records, it is uncertain whether the two can be distinguished reliably except at very close range. According to Caldwell and Caldwell (1989) *K. breviceps* lives in oceanic waters beyond the edge of the continental shelf while *K. sima* lives over or near the edge of the shelf. However, this separation of both species was not apparent in the study of Mullin et al. (1994) who, by aerial observation, found both species over water depths of 400-600 m in the North-Central Gulf of Mexico. These waters of the upper continental slope were also characterised by high zooplankton biomass (Baumgartner et al. 2001).

Behaviour: Similar to *K. sima* (Carwardine, 1995). When seen at sea, they generally appear slow and slug-gish, with no visible blow (Jefferson et al. 1993). *K.-breviceps* is said to be very easy to approach, lying quietly at the surface practically until touched although it will not approach boats by itself and is rather timid, slow moving and deliberate. Like its congener, *K. breviceps* spends considerable time lying motionless at the surface with the back of the head exposed and the tail hang-ing down loosely. *K. breviceps* is reported to float higher in the water with more of the head and back exposed than *K. sima* (Caldwell and Caldwell, 1989).

Schooling: Most sightings of pygmy sperm whales are of small groups of less than 5 or 6 individuals. Almost nothing is known of the behaviour and ecology of this species (Jefferson et al. 1993).

Food: Studies of feeding habits, based on stomach contents of stranded animals, suggest that this species feeds in deep water on cephalopods and, less often, on deep-sea fishes and shrimps (Caldwell and Caldwell, 1989; Jefferson et al. 1993; Santos and Haimovici, 1998).

5. Migration

Stranding data of both Kogiidae do not seem to bear out any strong seasonal changes in distribution nor any migrations, although some writers have suggested such in very general terms (Caldwell and Caldwel, 1989). Duguy (1994) suggests that the species may migrate from the coast to the open sea in summer, since most strandings e.g. In Florida occurred during winter and fall. In Europe, there are more strandings in winter, which supports this hypothesis.

6. Threats

Direct catch: Pygmy sperm whales have never been hunted commercially. Small numbers have been taken in coastal whaling operations off Japan and Indonesia (Jefferson et al. 1993).

Incidental catch: A few have been killed in Sri Lanka's gillnet fisheries, and it is likely they are killed in gillnets elsewhere as well (Jefferson et al. 1993). Perez et al. (2001) report on occasional by-catches in fisheries in the north-east Atlantic. However, although it is taken in small numbers both directly and incidentally in fisheries, Baird et al. (1996) find no serious threats to its status.

Pollution: Watanabe et al. (2000) present data on organic pollutants found in small cetaceans stranded on the coast of Florida and Marcovecchio et al. (1994) summarise the available knowledge on environmental contamination in marine mammals off Argentina. Tarpley and Marwitz (1993) report on a young male pygmy sperm whale stranded alive on Galveston Island, Texas, USA, which died in a holding tank 11 days later. During necropsy, the first two stomach compartments (forestomach and fundic chamber) were found to be completely occluded by various plastic bags.

7. Remarks

This species is insufficiently known with respect to all aspects of its biology and potential threats. Collection of by-catch and sighting data is strongly needed. For recommendations on Southeast Asian stocks, see Perrin et al. (1996). Not listed by the IUCN or by CMS.

8. Sources

Please see below in account on *Kogia sima*.

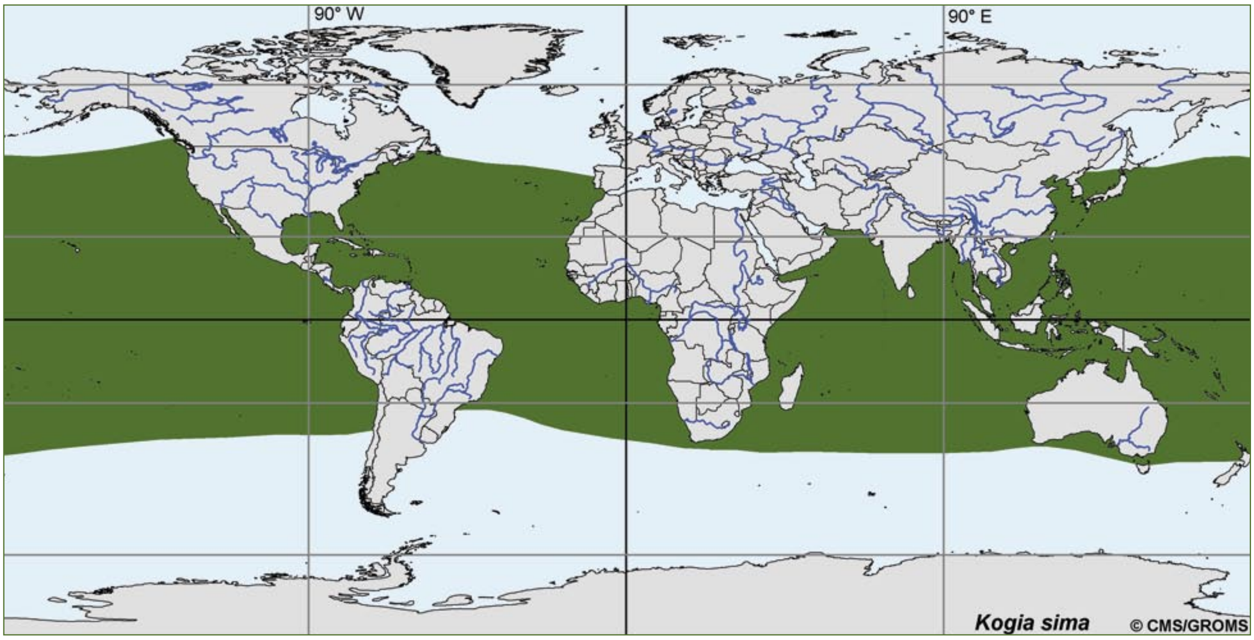
5.20 Kogia sima (Owen, 1866)

English: Dwarf sperm whale
German: Kleinpottwal
Spanish: Cachalote enano
French: Cachalot nain

Drawing of Kogia sima © Wurtz-Artescienza.

1. Description

Kogia spp. are porpoiselike, and robust, with a distinctive underslung jaw, not unlike sharks. They have the shortest rostrum among cetaceans and the skull is markedly asymmetrical. Dwarf sperm whales reach a maximum size of about 2.7 m total length and a body mass of 2,702 kg. Colouration in adults is dark blueish grey to blackish brown on the back with a light venter. On the side of the head, between the eye and the flipper, there is often a crescent-shaped, light-coloured mark referred to as a "false gill" (McAlpine, 2002).



Distribution of Kogia sima: deep temperate, subtropical, and tropical waters of the northern and southern hemispheres (mod. from Jefferson et al., 1993; © CMS/GROMS).

Kogia must be treated as feminine because it has a Latin feminine ending. Simus, -a, -um, is a Latin adjective, and therefore it must agree in gender with the generic name with which it is at any time combined. Thus the correct spelling of the scientific name of the dwarf sperm whale is *Kogia sima* (Rice, 1998), as opposed to *Kogia simus* in most publications to date.

2. Distribution

According to Caldwell and Caldwell (1989), there are two problems in trying to establish ranges for *Kogia*. First, members of this genus are only rarely identified at sea (and then usually not to species), and second, it is only recently that the two species have been clearly recognised as separate. As a consequence, most reliable records of either species are based on stranded individuals or occasionally on ones taken in fisheries.

Rice (1998) summarises that *K. sima* lives mainly over the continental shelf and slope off tropical and temperate coasts of all oceans. Range includes the western Atlantic from Virginia south to Rio Grande do Sul in Brazil, including the Antilles; the eastern Atlantic from the Mediterranean Sea south to Cape Province; The Indian Ocean from Cape Province north to Oman, east at least as far as Lomblen in Indonesia, and south to South Australia; the western Pacific from Chiba prefecture on the east coast of Honshu, and the Mariana Islands, south to Hauraki Gulf in New Zealand; and the eastern Pacific from Vancouver Island south to Valparaiso in Chile (Rice, 1998).

Although it was assumed that populations were continuous around the world, new molecular genetic results from Susan Chivers (pers. comm.) indicate that specimens of *K. sima* sampled from the Atlantic and Pacific ocean may represent different species, suggesting that there is little interchange between these two ocean basins.

3. Population size

Because of the lack of sightings at sea, which may be more because of its behaviour than true abundance, and the fact that *Kogia* is only rarely encountered in commercial fisheries where such records are often kept, there are no real estimates of abundance for either *Kogia* species (Caldwell and Caldwell, 1989).

Mullin et al. (1994) sighted dwarf sperm whales in the Gulf of Mexico over water depths between 400 and 600 m. The species accounted only for 1 % of the animals seen and occurred in 12 % of the herds observed during the aerial survey. Dolar (1999) estimated the population size in the eastern Sulu Sea at 650.

K. sima seems to be especially common off the southern tip of Africa and in the Gulf of California (Sea of Cortez), Mexico, where it occurs particularly close to shore. Most records are from strandings, which are relatively common in some places, though these may simply represent areas of most research rather than a true picture of distribution. Lack of records of live animals may be due to inconspicuous behaviour rather than rarity (Carwardine, 1995; Jefferson et al. 1993).

Recent strandings have been reported from Sable Island, Nova Scotia (Zoe and Hooker, 2000), the Gulf of Mexico (Delgado et al. 1998), British Columbia, Canada (Willis and Baird, 1998), the Azores (Goncalves et al. 1996), Ecuador (Felix et al. 1995), the Antilles (Debrot and Barros, 1992), the coast of France (Duguy, 1990) and Japan (Sylvestre, 1988), supporting the notion of a world-wide distribution.

4. Biology and Behaviour

Habitat: The dwarf sperm whale is an inconspicuous animal and generally lives a long way from shore (Jefferson et al. 1993). Rarely seen at sea, except in extremely calm conditions, it is the smallest of the whales and is even smaller than some dolphins. Predominantly a deep-water species, possibly concentrated over the edge of the continental shelf (closer to shore than the pygmy sperm whale). Appears to prefer warmer waters (Carwardine, 1995).

Behaviour: Rises to the surface slowly and deliberately and, unlike most other small whales (which roll forward at the surface), simply drops out of sight. Probably does not approach boats. May occasionally breach; leaping vertically out of the water and falling back tail-first or with a belly flop. Some records suggest that, when resting at the surface, it floats lower in the water than the pygmy sperm whale. Probably dives to depths of at least 300 m (Carwardine, 1995).

One of the few reported behavioural observations at sea stems from Scott and Cordado (1987) who report sighting a mother and calf after a purse-seine set was deployed on yellowfin tuna, *Thunnus albacares*, associated with a mixed school of spotted dolphins, *Stenella attenuata*, and spinner dolphins, *S. longirostris*. They were accidentally encircled. While inside the net, the female released into the water a cloud of reddish material, presumably faeces, 6-8 times during the course of the set. The mother released the faeces whenever a dolphin approached the calf; she then appeared to hide herself and the calf in the middle of the opaque cloud.

Schooling: Group sizes tend to be small, most often less than 5 individuals (although groups of up to 10 have been recorded (Jefferson et al. 1993).

Reproduction: In at least one area, there appears to be a calving peak in summer (Jefferson et al. 1993).

Food: Dwarf sperm whales appear to feed primarily on deep-water cephalopods (Jefferson et al. 1993) as well as on fish and crustaceans (Caldwell and Caldwell, 1989).

5. Migration

Duguy (1994) suggests that the species does not migrate extensively, since it can be observed year-round off African coasts.

6. Threats

Direct catch: Some small scale catches of dwarf sperm whales have been reported (Caldwell and Caldwell, 1989 and refs. therein). *K. sima* was encountered in a small harpoon fishery for pilot whales at St. Vincent in the Lesser Antilles, in Japan and occasionally in an aboriginal industry on Lomblen Island in Indonesia, and has been reported from fish markets in Sri Lanka.

Incidental catch: Caldwell and Caldwell (1989) suppose that it is unlikely that *Kogia* is significantly affected by humans. When taken in commercial fisheries the numbers are so few that either species is considered rare. However, Jefferson et al. (1993) believe that substantial numbers are taken each year in gillnets in the Indian Ocean, and possibly elsewhere. Zerbini and Kotas (2001) report on by-catch in the Brazilian driftnet fishery. Because of their small size and habit of often lying at the surface, apparently oblivious to approaching vessels, a few *Kogia* are probably run down and injured or killed (Caldwell and Caldwell, 1989).

Pollution: Both species have been reported with plastic bags in their stomachs that may have prevented digestion of food and ultimately brought death. Perhaps the textural or visual quality of the plastic was similar to that of squid and thus enticed the whales to devour it (Caldwell and Caldwell, 1989).

7. Remarks

This species has a world-wide distribution and is poorly known. Basic data on population sizes and impacts of threats on the population are lacking. Not listed by the IUCN or by CMS.

Both kogiid species also occur in southern South America. Recommendations iterated by the scientific committee of CMS for small cetaceans in that area (Hucke-Gaete, 2000) also apply (see Appendix 1). For recommendations on south-east Asian stocks, see Perrin (1996) in Appendix 2.

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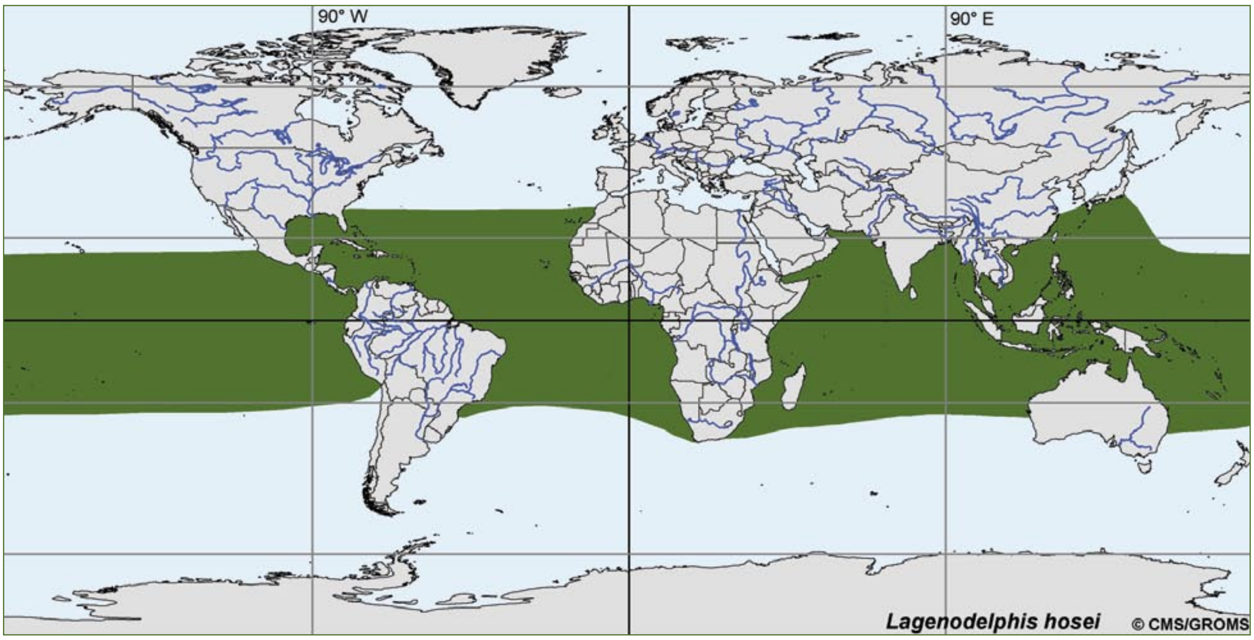
5.21 Lagenodelphis hosei (Fraser, 1956)

English: Fraser's dolphin
German: Borneo-Delphin
Spanish: Delfín de Fraser
French: Dauphin de Fraser

Drawing of Lagenodelphis hosei © Wurtz-Artescienza.

1. Description

The body of Fraser's dolphin is stocky, the beak short but distinct and the dorsal fin small, triangular and slightly falcate. The flippers and flukes are also comparatively small. The striking colouration varies with age and sex: a distinctive black stripe extending from the eye to the anus is absent or faint in juveniles, wider and thicker in adult males and variable in adult females. A similar pattern is observed with the facial stripe or "bridle". The back of *L. hosei* is brownish grey, the lower side cream-coloured and the belly is white or pink. The largest male recorded was 2.7 m and the largest female 2.6 m long. Large males can weigh up to 210 kg (Dolar, 2002). The one species in this genus was not recognized until 1956, when it was described from a single skull which had been picked up on a beach in Sarawak in 1895. It remained unknown to



Distribution of Lagenodelphis hosei: deep tropical and warm temperate waters of the Pacific, Atlantic and Indian Oceans between 30°S and 30°N (mod. from Jefferson et al. 1993, © CMS/GROMS).

science as a living animal until 1971, when the species was "rediscovered". Once its external features became known, it turned out that tuna fishermen in the eastern tropical Pacific were already familiar with it (Rice, 1998). Fraser's dolphin belongs to the subfamily delphinidae. Based on cytochrome b mtDNA it is more closely related to *Stenella*, *Tursiops*, *Delphinus*, and *Sousa* than to *Lagenorhynchus* (Dolar, 2002).

2. Distribution

Lagenodelphis hosei is pantropical and ranges north to the Gulf of Mexico, Islas Canarias, West Africa (van Waerebeek et al. 2000) Sri Lanka, Taiwan, southern Honshu, and Jalisco in Mexico and south to Uruguay and Brasil, Natal, Queensland, and Peru (Rice, 1998).

The distribution of this species is poorly known. It appears to be most common near the equator in the eastern tropical Pacific and at the southern end of Bohol Strait in the Philippines. It seems to be relatively scarce in the Atlantic Ocean, where it is known from the Lesser Antilles and the Gulf of Mexico (e.g. Mignucci-Giannoni et al. 1999) and recently from Venezuela (Bolaños and Villarroel-Marín, 2003). *Lagenodelphis hosei* may range across the Indian Ocean, though confirmed sightings exist only from the east coast of South Africa, Madagascar, Sri Lanka, and Indonesia. It also occurs away from the equator as far north as Taiwan and Japan and, in small numbers, off Australia. It is rarely seen in inshore waters, except around oceanic islands and in areas with a narrow continental shelf (Carwardine, 1995; Perrin et al. 1994). Dolar et al. (1997) report sightings between the Philippines and Malaysia, which, however, were so infrequent that they did not allow to estimate population density.

Strandings in temperate areas (Victoria in Australia, Brittany and Uruguay) may represent extralimital forays connected with temporary oceanographic anomalies such as the world-wide el Niño phenomenon in 1983-84, during which a mass stranding occurred in France (Perrin et al. 1994). Bones et al. (1998) report on a stranding on the coast of Scotland.

3. Population size

Estimates of abundance for the eastern tropical Pacific yield 289,500 Fraser's dolphins in that region (Perrin et al. 1994 and refs. therein). Gerrodette and Wade (1991) found that their 1989 relative abundance estimates in the eastern tropical Pacific Ocean were substantially higher than the 1988 estimates. In the Eastern Sulu Sea, Dolar (1999) estimated a total abundance of 8,700 Fraser dolphins.

4. Biology and Behaviour

Habitat: This dolphin is typically a high-seas animal; it has not been observed close to shore in shallow water. However, it may approach very close to shore (100 m) of some islands surrounded by deep water, e.g. Lesser Antilles, Indonesia and Philippines. In the eastern tropical Pacific, it forms part of an equatorial cetacean community that also includes *Physeter catodon*, *Globicephala macrorhynchus*, *Delphinus delphis*, *Stenella coeruleoalba* and *Peponocephala electra*. This community is more or less complementary in occurrence to another group of species that includes *Stenella attenuata*, *Stenella longirostris* and *Steno bredanensis*. The latter group is found primarily in so-called tropical surface water, where a stable, shallow mixed layer and thermocline ridging are dominant features. The former group occurs more often in Equatorial—southern subtropical surface water and other waters typified by upwelling and generally more variable conditions. Off South Africa, records are associated with the warm Agulhas Current that moves south in the summer (Perrin et al.1994 and refs. therein).

Behaviour: Analysis of prey suggests that Fraser's Dolphin is a deep diver, hunting at depths of at least 250-500 m (Carwardine, 1995). In some areas, it is considered shy and difficult to approach; in others it is a bit more approachable. It does not bowride in the eastern tropical Pacific, but it does in most other areas. Running herds create a great deal of white water (Jefferson et al. 1993).

Reproduction: The life history of Fraser's dolphin was examined by Amano et al. (1996) based on 108 specimens from a school captured by the driving fishery in Japan. The sex ratio was approximately 1:1. The annual ovulation rate was 0.49. The estimated neonatal length (110 cm) predicts a gestation period of about 12.5 mo. and calving peaks in spring and probably also in fall. The calving interval was estimated to be about 2 yr. Life history parameters are similar to those of the striped and pantropical spotted dolphins, but reproductive rate of this species may be lower than that of other pelagic delphinids, if the observed shorter longevity is real.

Schooling: Herds tend to be large, consisting of hundreds or even thousands of dolphins, often mixed with other species, such as melon-headed whales (*Peponocephala electra*), short-finned pilot whales (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), spinner dolphin (*Stenella longirostris*) pantropical spotted dolphin (*S. attenuata*), bottlenose dolphins (*Tursiops truncatus*) and sperm whales (Perrin et al.1994 and refs. therein; Dolar, 2002).

Food: In the eastern Pacific, Fraser's dolphin feeds on mesopelagic fish, shrimps and squids. It rarely associates there with bird flocks or tuna schools, which correlates well with the absence of surface-dwelling prey from its diet. In other regions, e.g. the southern Indian Ocean and the western Pacific, it may also feed far below the surface. The stomachs of animals stranded in Brittany contained only the remains of fish (4-24 cm long; four species) and the cephalopod *Sepia sp*. indicating benthic or mesopelagic feeding preferences (Perrin et al. 1994). Based on stomach contents, prey in the eastern tropical Pacific may be taken at between 250 and 500 m water depths (Dolar, 2002). Santos and Haimovici (1998) report on the preference for loliginid squids in the diet of *L. hosei* stranded in southern Brazil. Watkins et al. (1994) report on co-operative hunting techniques observed in the Caribbean.

5. Migration

There are no detailed reports on migratory behaviour, although this pelagic species regularly approaches islands where it is captured for human consumption (see below).

6. Threats

Direct catch: Small numbers of Fraser's dolphins are taken in local subsistence harpoon fisheries in the Lesser Antilles, Indonesia, the Philippines and probably elsewhere in the Indopacific. A few are taken in drive fisheries in Taiwan and Japan (Perrin et al. 1994 and refs. therein). Dolar et al. (1994) investigated directed fisheries for marine mammals in central and southern Visayas, northern Mindanao and Palawan, Philippines, from archived reports and visits to sites where such fisheries are conducted. Some of the hunters take only dolphins, for bait or human consumption and the species taken include Fraser's dolphins. These are taken by hand harpoons or, increasingly, by togglehead harpoon shafts shot from modified, rubber-powered spear guns. Around 800 cetaceans are taken annually by hunters at the seven sites, mostly during the inter- monsoon period of February-May. Dolphin meat is consumed or sold in local markets and some dolphin skulls are cleaned and sold as curios (Dolar et al. 1994).

Incidental catch: Some are killed incidentally in the tuna purse-seine fishery in the eastern tropical Pacific: 26 were estimated taken during the period 1971-75. A few are also taken in gill nets in Sri Lanka, the Philippines, and likely in other tropical gillnet fisheries as well. Some are killed by anti-shark nets (Perrin et al. 1994 and refs. therein; Dolar et al. 1999; Cockroft, 1990). Gerrodette and Wade (1991) note that *Lagenodelphis hosei* is taken incidentally by tuna purse seiners for the yellowfin tuna (*Thunnus albacares*) fishery in the eastern tropical Pacific.

7. Remarks

On 16 December 1992 the Department of Agriculture of the Philippines issued Fisheries Administrative Order No. 185, 'banning the taking or catching, selling, purchasing, possessing, transporting and exporting of dolphins'. The order did not stop dolphin and whale hunting but seems to have decreased the sale of dolphin meat openly in the market. Investigations are encouraged to ensure that these artisanal whale fisheries operate within sustainable limits and do not export products illegally (Dolar et al. 1994). This recommendation can also be extended to other populations of Fraser's dolphins. For South American stocks, see fur-ther recommendations in Hucke-Gaete (2000) in Appendix 1; for Southeast Asian stocks see general recommendations in Perrin et al. (1996) in Appendix 2.

The species is poorly known with respect to its distribution, migratory behaviour and abundance and by-catch rates are poorly documented.

L. hosei is listed as "Data Deficient" by the IUCN . The southeast Asian populations are listed in Appendix II of CMS.

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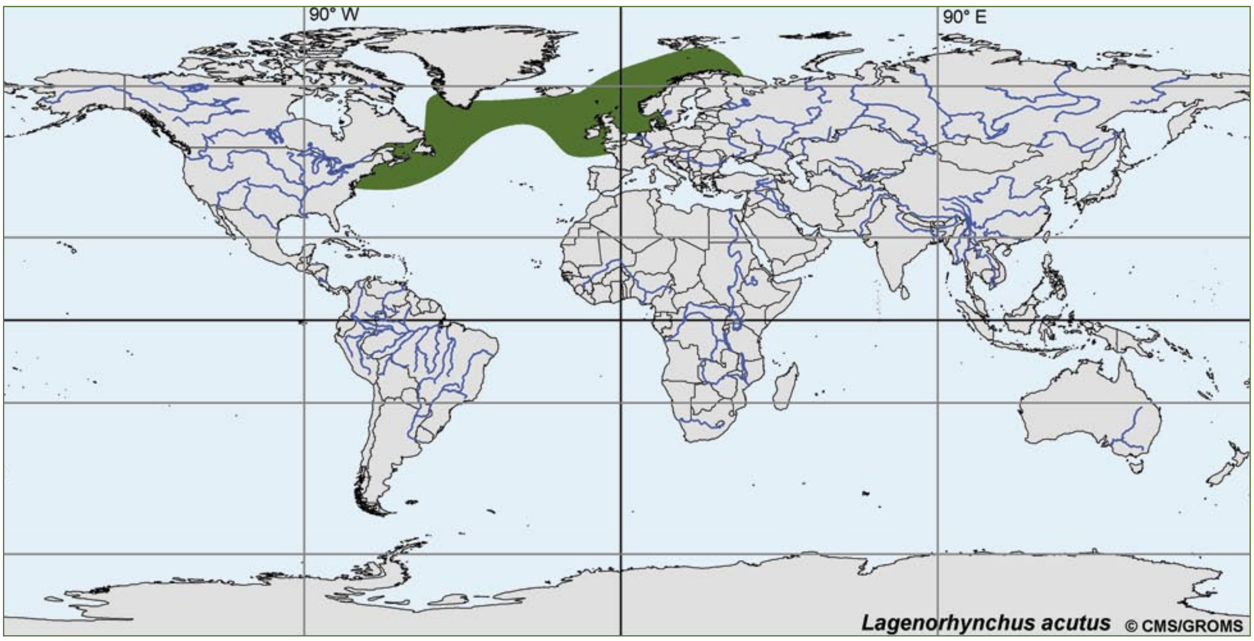
5.22 Lagenorhynchus acutus (Gray, 1828)

English: Atlantic white-sided dolphin
German: Weißseitendelphin
Spanish: Delfín de costados blancos
French: Dauphin à flancs blancs

Drawing of Lagenorhynchus acutus © Wurtz-Artescienza.

1. Description

Atlantic white-sided dolphins are robust and powerful, impressively patterned, and more colourful than most dolphins. A narrow, bright white patch on the side extends back from below the dorsal fin and continues towards the flukes as a yellow blaze above a thin dark stripe. The back and dorsal fin are black or very dark grey, as are the flippers and flukes, whereas the belly and lower jaw are white, and the sides of the body are light grey. A black eye ring extends in a thin line to the upper jaw and a very thin stripe extends backward from the eye ring to the external ear. A faint grey stripe may connect the leading edge of the flipper with the rear margin of the lower jaw. The beak is short (Cipriano, 2002).



Distribution of Lagenorhynchus acutus (mod. from Cipriano, 2002): cool, temperate and subarctic waters of the northern North Atlantic; © CMS/GROMS).

Male Atlantic white sided dolphins reach 270 cm and 230 kg, whereas adult females are about 20 cm shorter and 50 kg lighter (Cipriano, 2002).

2. Distribution

L. acutus is a deepwater species which ranges across the North Atlantic, from south-eastern Labrador (52˚N) east to Trondheimsfjord in Norway, south to Long Island in New York, the Azores, and the Strait of Gibraltar (Rice, 1998).

Towards the east of the range, *L. acutus* may occasionally be found as far north as the southern Barents Sea and rarely further south than the English Channel. In the west, it has been reported from west Greenland to Chesapeake Bay, USA (though usually from Cape Cod, USA, northwards). The species appears to be especially abundant in the Gulf of Maine, USA, and large schools penetrate far up the St. Lawrence estuary, Canada (Carwardine, 1995; for details see Reeves et al. 1999).

The species is vagrant to Virginia and south-western Greenland (Rice, 1998) and rarely enters the Baltic Sea (Jefferson et al. 1993; Kinze et al. 1997 and pers. obs.).

Mikkelsen and Lund (1994) found no evidence of separate populations based on a study of metrical and non-metrical skull characters of 123 Atlantic white-sided dolphins from much of the species' range.

3. Population size

The number of Atlantic white-sided dolphins in the western North Atlantic, from the southern Gulf of Maine and north-eastwards on the continental shelf and slope to Cabot Strait were about 27,000 in July – September 1995 (Palka et al. 1997) and at least 12,000 in the Gulf of St. Lawrence (Kingsley and Reeves, 1998).

Weir et al. (2001) carried out surveys to the north and west of Scotland and found that Atlantic white-sided dolphins were the most abundant species in the region with a total of 6,317 animals recorded.

Evans (1987, in Reeves et al. 1999) suggests a total population throughout the North Atlantic of tens of thousands to low hundreds of thousands. Cipriano (2002) gives a figure of 40,000 for the western Atlantic and a few hundred thousand for the entire Atlantic.

4. Biology and Behaviour

Habitat: *L. acutus* seems to prefer areas with high seabed relief along the edge of the continental shelf (Carwardine, 1995). Mean surface water temperature for a sample of 86 sightings off the north-eastern United States was 7.0 ± 2.9°C (Reeves et al. 1999).

Behaviour: *L. acutus* is an acrobatic and fast swimmer and frequently breaches (though not as often as white-beaked or common dolphins) and lobtails. It surfaces to breathe every 10 to 15 seconds, either leaping clear of the water or barely breaking the surface and creating a wave over its head. *L. acutus* is wary of ships in some areas (Palka and Hammond, 2001), but will swim alongside slower vessels and may bow-ride in front of faster ones. Sometimes it can be observed riding the bow-waves of large whales. Individual and mass strandings are relatively common (Carwardine, 1995; Jefferson et al. 1993). The species is presumably not a deep diver, as maximum recorded dive times were 4 min, and most dive times were shorter than 1 min (Cipriano, 2002).

Schooling: Herds of up to several hundred are seen, and there is some age and sex segregation among these. Older immature individuals are not generally found in reproductive herds of mature females and young (Jefferson et al. 1993; Reeves et al. 1999). Gaskin (1992) hypothesized that Atlantic white-sided dolphins split into small groups for feeding and that such small groups merge into large aggregations "while migrating". Groups often associate and probably feed with fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*) and long-finned pilot whales (*Globicephala melas*). Mixed herds of Atlantic white-sided dolphins and white-beaked dolphins have been observed in the North Sea (Reeves et al. 1999, and refs. therein).

Reproduction: Parturition in the western North Atlantic usually takes place between May and August, with a peak in June and July, following an estimated 11 month gestation period. The timing of parturition is apparently similar in the eastern North Atlantic, where sightings have been interpreted to suggest "breeding areas" offshore in the North Sea and in the Atlantic to the north and west (Reeves et al. 1999 and refs. therein).

Food: Atlantic white-sided dolphins feed on small schooling fish and squid. These include herring (*Clupea harengus*) and small mackerel (*Scomber scombrus*), silvery pout (*Gadiculus argenteus*), blue whiting (*Micromesistius poutassou*), American sand lance (*Ammodytes americanus*), smelt (*Osmerus mordax*), and silver hake (*Merluccius bilinearis*) and short-finned squid (*Illex iilecebrosus*) (Jefferson et al. 1993; for details see Reeves et al. 1999). In the North Sea, oceanic cephalopods seem to be their main diet (Das et al. 2000). Different prey species may predominate at different times of year, representing seasonal movements of prey, or in different areas, indicating prey and habitat variability in the environment (Cipriano, 2002). Atlantic white-sided dolphins apparently co-operate in their efforts to contain and attack schools of fish, a behaviour which is similar to that described for dusky dolphins off Argentina (Reeves et al. 1999 and refs. therein).

5. Migration

There may be inshore—offshore movements with the seasons in some areas (Carwardine, 1995). Selzer and Payne (1988) suggest that *L. acutus* moves south along the continental shelf edge in winter and spring, in association with the relatively cold, less saline Gulf of Maine water flowing southwards through Northeast Channel during these seasons. They sighted *L. acutus* more frequently in areas of high sea floor relief, and in areas where sea surface temperatures and salinities are low. Seasonal variation in sea surface temperature and salinity, and local nutrient upwelling in areas of high sea floor relief may affect preferred prey abundances, which in turn may affect dolphin distribution. The occurrence of Atlantic white-sided dolphins off Newfoundland seems to be seasonal, mainly from July to October (Reeves et al. 1999). Data from one satellite-monitored dolphin indicated an ability to travel long distances at a speed of at least 14 km/hr (Mate et al. 1994).

Weinrich et al (2001) report that off New England they sighted 1,231 groups of Atlantic white-sided dolphins between April and from October 1984 through 1997, primarily on Stellwagen Bank and Jeffreys Ledge (two shallow glacial deposits along the coasts of Massachusetts, New Hampshire, and Maine). Mean group size was 52, and was significantly larger from August through October (71.9) than April through June (35.0).

Couperus (1997) investigated the occurrence of incidental cetacean catches in the Dutch pelagic trawl fishery. These are largely restricted to late-winter early-spring in an area along the continental slope south-west of Ireland and available evidence indicates that annual variations are large. It seems that the Atlantic white-sided dolphin is normally a more oceanic species, but will actively search for mackerel (*Scomber scombrus*) closer to shore in early spring. Fresh mackerel remains were found in nearly all white-sided dolphin stomachs caught as by-catch, whereas deep-water fish otoliths suggested that the dolphins had a completely different diet before moving to the south-west of Ireland.

6. Threats

Direct catch: Some hunting for this species occurred in the past, especially in Norway. Some are still taken in Greenland, the Faeroe Islands, and eastern Canada (Jefferson et al. 1993; Reeves et al. 1999 and refs. therein).

Incidental catch: Incidental mortality in fishing gear has been documented off Canada, the United States, the United Kingdom and Ireland. Gaskin (1992) judged Atlantic white-sided dolphins to be less vulnerable to capture in pelagic near-surface drift nets and fixed groundfish gill nets than are many other small cetaceans. They may, however, be especially susceptible to capture in midwater trawl nets (Addink et al., 1997). Substantial numbers have been by-caught in pelagic trawl fisheries for horse mackerel and mackerel south-west of Ireland (Reeves et al. 1999 and refs. therein).

Starting in 1990, a deep water trawl fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in the NAFO Regulatory Area was developed by Spain. Information about fishing operations and their interactions with marine mammals was obtained in more than 14,000 individual hauls. The rate of sets with incidental mortality was 0.27%, but 73.8% of this mortality corresponded to seals. Only 42 cetaceans were caught, which also included Atlantic white-sided dolphins. It seems that the Greenland halibut fishery has a relatively low level of incidental marine mammal mortality (Lens, 2001).

Morizur et al. (1999) investigated marine mammal by-catch in 11 pelagic trawl fisheries operated by four different countries in the Northeast Atlantic. One of the main marine mammal species identified in by-catches was *L. acutus*. Mean dolphin catch rate for all fisheries combined was 0.048 per tow (one dolphin per 20.7 tows), or 0.0185 per hour of towing (one dolphin per 98 h of towing). All dolphin by-catches occurred during the night. White-sided dolphins were observed feeding around the net during towing and this behavior may make them more vulnerable to capture. Operational difficulties in observing by-catch and potentially significant annual fluctuation in catch rates warrant further observer studies of these and other trawl fisheries.

Pollution: A juvenile dolphin from the north-west coast of Ireland was found to have a relatively high concentration of mercury in its liver (44 ng per g wet weight). An adult male from Nova Scotia had moderately high levels of organochlorines in its blubber (Reeves et al. 1999 and refs. therein).

7. Remarks

Atlantic white-sided dolphins seem to be migratory in North America, where range states are the USA, Canada and France (St. Pierre et Miquelon). The species occurs off and on in the North Sea and around Ireland, and range states include Ireland, Great Britain, France, the Netherlands, Belgium, Germany, Denmark, Norway, Sweden, Iceland and Greenland.

Operational difficulties in observing by-catch and potentially significant annual fluctuation in catch rates warrant further observer studies of these and other trawl fisheries (Morizur et al. 1999).

IUCN Status: "not listed". The North and Baltic Sea populations are listed in Appendix II of CMS, but inclusion of the NW Atlantic stock into CMS is recommended on the basis of observed migrational behaviour.

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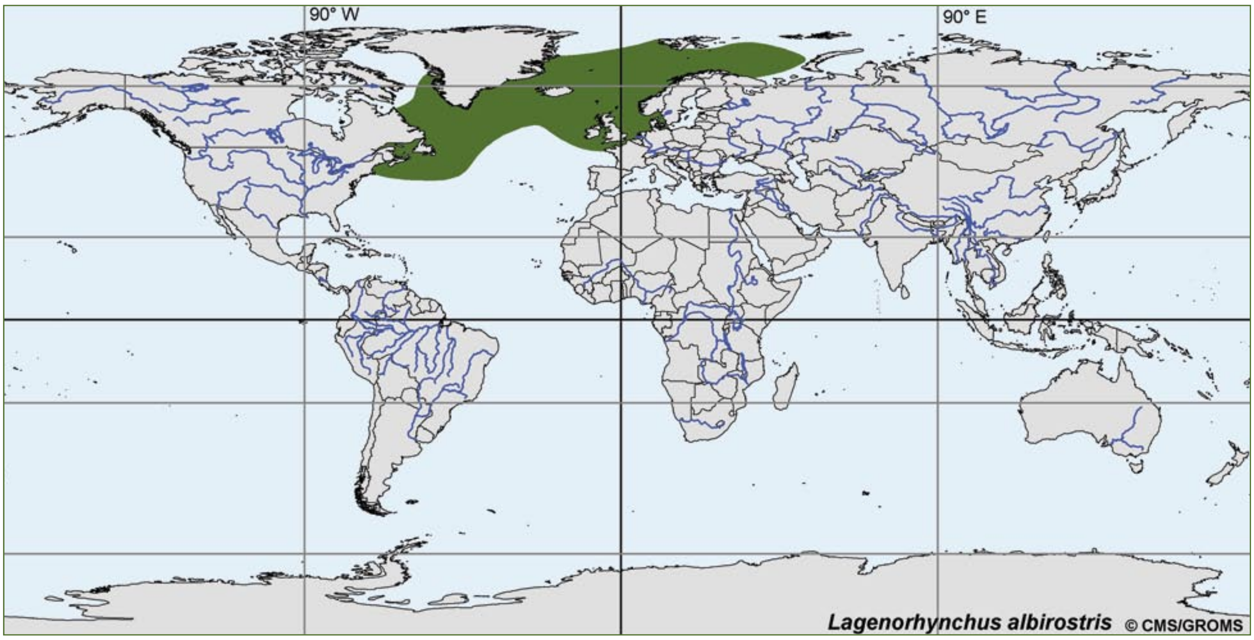
5.23 Lagenorhynchus albirostris (Gray, 1846)

English: White-beaked dolphin
German: Weißschnauzendelphin
Spanish: Delfín de pico blanco
French: Dauphin à bec blanc

Drawing of Lagenorhynchus albirostris © Wurtz-Artescienza.

1. Description

The white-beaked dolphin has a robust appearance. Its beak is only 5-8 cm long. The dorsal fin is in the middle of the back, erect and strongly curved. Adults grow between 2.4 and 2.1 m long and may weigh between 180 and 350 kg. Males usually grow larger than females. The coloration is typically black on the back, with a white saddle behind the dorsal fin and whitish bands on the flanks that vary in intensity from a shining white to ashy grey. Belly and beak are normally white, but the beak may be ashy grey or even darker, which may appear as if a white beak was missing (Kinze, 2002).



Distribution of Lagenorhynchus albirostris: cool temperate and subarctic waters of the North Atlantic (mod. from Reeves et al. 1999; © CMS/GROMS).

Populations in the eastern and western North Atlantic are separable on the basis of skull characters (Mikkelsen and Lund, 1994), but no subspecies have been named.

2. Distribution

This is the most northerly member of the genus *Lagenorhynchus*, and has a wide distribution. Animals in the northernmost part of the range occur right up to the edge of the pack-ice (Carwardine, 1995). The species is found in the immediate offshore waters of the North Atlantic, off the American coast from Cape Chidley, Labrador, to Cape Cod, Massachusetts; the Southwest coast of Greenland north to Godthab; off the European coast from Nordkapp in Norway south through the North Sea to the British Isles, Belgium, the Netherlands, Denmark, and the south-western Baltic Sea (Rice, 1998).

The main concentrations around the British Isles are off northern Scotland (including the Outer and Inner Hebrides, Orkney and Shetland islands) and along portions of the Atlantic coast of Ireland. They are common in the northern and central North Sea and in the Kattegat and Skagerrak between Jutland (Denmark), Norway and Sweden. It is the most common delphinid stranded and sighted in Dutch waters and is common around the Faroe Islands. It is also considered the most common dolphin off south-eastern Greenland, in Denmark Strait and the seas around Iceland (Reeves et al. 1999; Kinze et al. 1997).

L. albirostris is vagrant to France, the north coast of Spain, the Strait of Gibraltar, and the Mediterranean Sea (Rice, 1998). Although it occurs as far south as Portugal, it is rarely seen south of Britain (Carwardine, 1995) and only occasionally in inner Danish waters (Reeves et al., 1999) and the Baltic proper (Kinze, 2002).

3. Population size

Published estimates indicate a population of at least several thousand white-beaked dolphins in portions of the north-western Atlantic: shoreward of the 200 m contour between St. Anthony, Newfoundland, and Nain, Labrador (Alling and Whitehead, 1987) and in coastal and offshore waters east of Newfoundland and south-east of Labrador. In the Gulf of St. Lawrence for instance, white-beaked dolphins (2,500 in 1995 and 1996) occurred only in the Strait of Belle Isle and the extreme north-eastern Gulf (Kingsley and Reeves, 1998).

It seems that at least a few thousand white-beaked dolphins inhabit Icelandic waters and up to 100,000 the north-eastern Atlantic including the Barents Sea, the eastern part of the Norwegian Sea and the North Sea north of 56°N. A survey of the North Sea and adjacent waters in 1994 provided an estimate of 7,856 white-beaked dolphins. The total number of white-beaked dolphins throughout the North Atlantic thus may be in the high tens or low hundreds of thousands (Reeves et al. 1999 and refs. therein). Kinze et al. (1997) maintain that the white-beaked dolphin is much more common in the North and Baltic Seas than its relative, the white-sided dolphin and Northridge et al. (1997) find that white-beaked dolphins are relatively common in European waters compared with white-sided dolphins, or compared with US waters.

4. Biology and Behaviour

Habitat: The species is found widely over the continental shelf, but especially along the shelf edge (Carwardine, 1995).

Behaviour: *L. albirostris* may bow-ride, especially in front of large, fast-moving vessels, but usually it loses interest quickly. However, some populations are very elusive. Sometimes acrobatic (especially when feeding) and when it breaches it normally falls onto its side or back. Typically a fast, powerful swimmer. *L. albirostris* has been seen with Fin and Killer Whales, and may mix with other species (Carwardine, 1995).

Reproduction: There appears to be a calving peak in summer and early autumn, but not much is known about reproduction in this species (Jefferson et al. 1993).

Food: In all areas where stomach contents have been examined, clupeids (e.g. herring), gadids (e.g. Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), poor-cod (*Trisopterus minutus*, *T. luscus*), whiting (*Merlangius merlangus*), capelin (*Mallotus villosus*) and hake (*Merluccius merluccius*) have been found to be the principal prey of white-beaked dolphins. Other studies include *Scomber*, *Pleuronectes*, *Limanda*, *Eleginus* and *Hyperoplus* as well as squid, octopus and benthic crustaceans as prey (Reeves et al. 1999 and refs. therein).

Schooling: Groups of less than 50 are most common, but herds of many hundreds have been seen. While feeding they sometimes associate with large whales such as fin and humpback whales, but also with herds of pilot whales, sei whales, killer whales, bottlenose dolphins, white-sided dolphins and common dolphins

(Jefferson et al. 1993; Reeves et al. 1999 and refs. therein). In contrast to the Atlantic white-sided dolphin, which sometimes mass strands, the white-beaked dolphin usually strands singly or in small groups. Cooperative feeding has been described. Dolphins herd the fish into a tight cluster and trap them against the surface (Reeves et al. 1999 and refs. therein).

5. Migration

In some areas, *L. albirostris* may make inshore—offshore or north—south movements with the seasons (wintering in the south or offshore); in other areas, such as Britain, they seem to be present all year round (but with seasonal peaks of abundance in coastal waters) (Carwardine, 1995). Northridge et al. (1997) summarise that white-beaked dolphins around the British Isles have a fairly consistent distribution throughout the year, although during spring they appear to aggregate around two areas of concentration to the north of Scotland and off the Yorkshire coast.

Sightings of white-beaked dolphins are common around Newfoundland during the winter and spring and fishermen along the Labrador coast claim that they approach the coast in late June and remain until October (Ailing and Whitehead, 1987). Densities on the Southeast Shoal of the Grand Banks decreased from mid June to mid July (Reeves et al. 1999 and refs. therein).

6. Threats

Direct catch: There is a long history of hunting for white-beaked dolphins in Norway, the Faeroe Islands, Greenland, and Labrador. During the early 1980s an estimated 366 white-beaked dolphins were taken annually by the residents of 12 Labrador harbours (Alling and Whitehead, 1987). Hunting in some areas continues today (Jefferson et al., 1993), e.g. southwest of Greenland (Kinze, 2002).

Incidental catch: White-beaked dolphins have been taken in fishing gear in many areas and at least the Newfoundland/Labrador by-catch is substantially under-reported in published accounts (Reeves et al. 1999). However, incidental catches are not thought to be high enough to represent a threat to this species (Jefferson et al. 1993). De Haan et al. (1998) outline possible mitigation measures for the pelagic trawl fishery.

Pollution: Like other North Atlantic marine mammals, white-beaked dolphins are contaminated by organochlorines, other anthropogenic compounds and heavy metals (Reeves et al. 1999 and refs. therein). Siebert et al. (1999) report concentrations of total mercury and methylmercury in muscle, kidney and liver samples of three white-beaked dolphins, stranded or by-caught from the German waters of the North and Baltic Seas.

7. Remarks

This is a species which occurs frequently in European and North American waters and range states are therefore the US, Canada, Greenland, Iceland, Norway, Sweden, Denmark, Germany, The Netherlands, Belgium, France and Great Britain.

By-catch rates seem to be poorly documented and warrant mitigation measures. There seem to be seasonal inshore/offshore as well as north/south movements, which may cross the national boundaries of several of the states mentioned.

IUCN Status: "not listed". The North and Baltic Sea populations are listed in Appendix II of CMS. However, white-beaked dolphin abundance seems also to vary throughout the year off north-eastern North America, suggesting possible seasonal migrations. Therefore this stock (Range states US and Canada) should also be included in CMS App. II.

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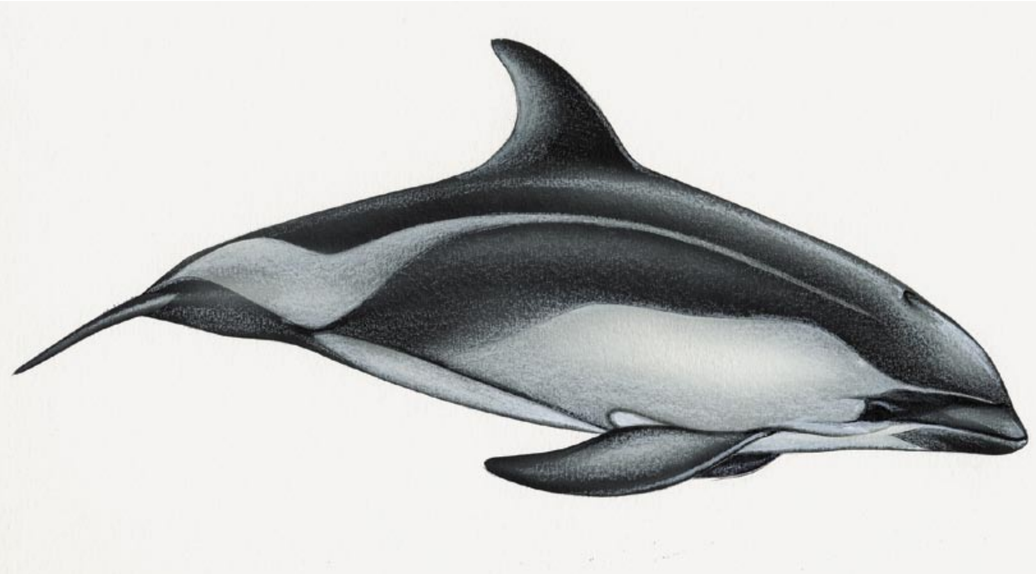
5.24 Lagenorhynchus australis (Peale, 1848)

English: Peale's dolphin
German: Peale Delphin
Spanish: Delfín austral
French: Dauphin de Peale



Drawing of Lagenorhynchus australis © Wurtz-Artescienza.

1. Description

L. australis is a stocky dolphin with the barest indication of a beak. Length ranges from 130–210 cm in females and 138–218 cm in males, and adults are on average 190–199 cm long. The heaviest animal weighed 115 kg. Colour is dark grey or black on the back, with two areas of lighter shading on the flanks. A curved white-to-grey flank patch angles forward from the vent, narrowing to a single line ending below or in front of the dorsal fin. The posterior curves of the flank patch almost meet above the tail stock. The larger thoracic patch is light to medium grey, outlined with a narrow dark line on its lower surface. A double black eye-ring extends forward onto the inconspicuous snout. Flippers of older animals may have a series of small knobs on the leading edge. The ventral surface behind the throat patch is white, with a few dark streaks in the genital area. Younger animals are lighter grey than adults. Peale's dolphins can be confused with dusky dolphins (see *L. obsucurus*, page 135) through much of their range (Goodall, 2002).

Distribution of Lagenorhynchus australis: cool, coastal waters of southern South America including the Falkland / Malvinas Islands (mod. from Goodall, 2002; © CMS/GROMS).

2. Distribution

Peale's dolphin ranges in coastal waters of southern South America from Valdivia, Chile (38°S), and Golfo San José, Argentina (44°S), south to Beagle Canal and Falkland Islands / Islas Malvinas (Goodall et al. 1997a; Goodall, 2002).

L. australis is most common south of Puerto Montt, Chile, and particularly common around the Falkland Islands and Tierra del Fuego (especially the Straits of Magellan and Beagle Channel). It is one of the most frequently sighted cetacean species in the Straits of Magellan. The distribution may be continuous between Argentina and the Falklands (Carwardine, 1995).

L. australis may occur further north in both countries and was recorded as far north as Provincia Buenos Aires, Argentina, and Concón, Chile (Brownell et al. 1999; Goodall et al. 1997a). Records from southern

Brazilian waters (41-32°S) have recently been reported by Pinedo et al. (2002; not shown on the map). A group of dolphins closely observed and photographed near Palmerston Atoll (18°S, 163°W) in the Cook Islands also appear to be this species (Brownell et al. 1999). The southernmost sighting until recently was at 57°S; there is one new sighting at 59°10'S in the Drake Passage (Goodall et al. 1997b).

3. Population size

No substantial information is available about the abundance of *L. australis*. However, this species is reportedly the most common cetacean found around the coast of the Falkland Islands and Chile (Brownell et al. 1999; Goodall et al. 1997a). There seems to have been a marked decrease in the number of sightings in areas of the extreme south where crab fishing takes place (Carwardine, 1995).

4. Biology and Behaviour

Habitat: Peale's dolphins are often seen near the coast, and so are easily observed. They occupy two major habitats: open, wave-washed coasts over shallow continental shelves to the north; and deep, protected bays and channels to the south and west. In the channels, this is an 'entrance animal', associated with the rocky coasts and riptides at the entrance to fjords, where the highest water temperature recorded was 14.7°C. Peale's dolphins show a high degree of association with kelp beds (*Macrocystis pyrifera*), especially in the channel regions. They swim and feed within, inshore and offshore of the kelp forests, using natural channels for movement. Over much of its range Peale's dolphin is sympatric with the dusky dolphin, *L. obscurus*, although their usages of habitats are slightly different. These two species are often difficult to differentiate at sea (Goodall et al. 1997b; de Haro and Iniguez, 1997). Throughout the northern part of its range, they inhabit the waters of the wide continental shelf off Argentina and the narrower shelf off Chile. Although Peale's dolphins have been observed in waters at least 300 m deep, they appear to prefer shallower coastal waters (Brownell et al. 1999 and refs. therein).

Behaviour: Peale's dolphin is known to ride bow-waves of large vessels and may swim alongside smaller ones. It sometimes swims slowly, but can be energetic and acrobatic, frequently leaping high into the air and falling back into the water, on its side, with a splash. It has been observed playing in surf in the company of Risso's Dolphins (Carwardine, 1995).

Reproduction: The young are born from spring to autumn, October to April (Goodall et al. 1997a).

Schooling: Peale's dolphins have been seen in small groups of 2-30 and may associate with Risso's and Commerson's dolphins (Jefferson et al. 1993; Brownell et al. 1999 and refs. therein).

Food: The stomachs of three *L. australis* incidentally killed in fishing gear off southern Patagonia, Argentina contained molluscs, crustaceans and fish. The most frequently encountered prey were the kingklip fish (*Genypterus blacodes*), the shrimp, (*Pleoticus muelleri*) and the squid (*Loligo gahi*) (Brownell et al. 1999). Schiavini et al. (1997) studied the stomach contents of nine specimens recovered from Tierra del Fuego which included eight species of fish, three cephalopods, one bivalve mollusc, two crustaceans, and one species of salp. Of these, the most important prey species were bottom fish, namely hagfish (*Myxine australis*), southern cod (*Salibota australis*) and Patagonian grenadier (*Macruronus magellanicus*), octopus (*Enterocto-pus megabocyatizus*) and squid (*Loligo gahi*). The feeding ecology of *L. australis* appears to be associated with demersal and bottom species taken in or near kelp beds. Dive times range from 3-157 s, with an average of 28 s (Goodall 2002 and refs. therein).

5. Migration

Evidence from photoidentification studies suggests that some dolphins spend the entire year in limited areas close to shore, in the Strait of Magellan (Jefferson et al. 1993; Carwardine, 1995). Although there is no published information on the movements of this species at this time (Brownell et al. 1999), at least some of the population appears to move offshore in winter, but more observations are needed (Goodall et al. 1997b).

On the west coast of the Strait of Magellan, Chile, land-based surveys indicate that higher total animal counts are registered during summer months (December to February) compared to winter periods. Land-based surveys showed an increase in abundance in the southern compared to the central portion of the area during spring, and a more homogeneous distribution during the rest of the year. Although total abundance increases in summer, compared to the winter period, both seasons show less marked preference for a specific sector. Concentration in the southern part of the study area during spring appears to be related to the calving season that can be observed as early as

October. Individual identification shows at least part of the population to be residential throughout the year, while another observation of one individual documents a range of at least 300 km (Lescrauwaet, 1997).

6. Threats

Direct catch: There is considerable concern about unknown numbers of Peale's Dolphins that become accidentally entangled in fishing nets and are hunted with harpoons in the Strait of Magellan and around Tierra del Fuego; the meat is used as bait in crab traps (Carwardine, 1995; Jefferson et al. 1993). Although direct hunting of dolphins has been prohibited in Chile since 1977, crab traps for centolla (southern king crab), *Lithodes antarctica* and centollon (false king crab), *Paralomis granubosa*, are still set with dolphin meat. Fishermen who supply dolphins to crab fishermen claim that crabs prefer dolphins to other animals and birds. No recent estimates are available on the number of marine mammals killed for bait, and it has been recommended to collect more definitive statistics on animals used for bait in the crab fishery (Brownell et al. 1999). There are no recent estimates on dolphin mortality abundance in this region (Lescrauwaet, pers. comm.) but it is thought to be lower than in the past (Goodall, 2002). Dolphin takes in the Argentinian sector have been stopped after the early 1980's (Goodall, 2002).

Incidental catch: Peale's dolphins are incidentally entangled and drowned in nets (Jefferson et al. 1993). There are reports from Queule and Mehuin (Chile), southern Patagonia, north-eastern Tierra del Fuego and southern Santa Cruz (Argentina) that local fishermen may incidentally catch Peale's dolphins (Brownell at al. 1999, Reyes, 1991 and refs. therein). In the northern part of their Pacific range, however, Peale's dolphins seem to be rarely taken (Goodall 2002).

Pollution: Some residues of organochlorine contaminants were found in a single specimen of *L. australis* from Argentine waters. Dieldrin (0.620 ppm), Heptachlor (0.050 ppm), HCB (0.094 ppm), HCH (0.067 ppm) and DDT (0.405 ppm) were present in the blubber of this specimen (Brownell et al. 1999 and refs. therein).

7. Remarks

This species is poorly known with respect to abundance, migratory behaviour and mortality in anthropogenic operations. Exploitation for crab bait in the southern part of its range was extensive in the 1980s but crab fishing effort has lessened through the overexploitation of crabs. Alternative bait is now more available and there seems to be a change from (overexploited-) crab to sea urchin exploitation. Offshore fishing represents a potential danger that should be monitored (Goodall et al. 1997a). Although the potential impact of crab-fisheries must have diminished considerably (there is more control and better availability of legal bait like fish and slaughterhouse wastes) there is still a—not analysed nor estimated—indication that small amounts of wildlife are still being taken in this fishery. New research in the field is needed to update these data (Lescrauwaet, pers. comm.).

L. australis is included in Appendix II of CMS based on the fact that movements of dolphins through the Beagle Channel (if not through the Strait of Magellan also) are likely to involve the national boundaries of Argentina and Chile. IUCN Status: "Data Defficient".

Recommended actions for conservation include enforcement of regulations in both Argentina and Chile, cooperative research on biology and abundance, collection of definite statistics on bait usage and development of alternative sources of bait. In the meantime campaigns to inform the citizenry, environmental organizations and the importing nations of the illegal aspects and the environmental effects of the crab fishery are needed (Reyes, 1991). See also recommendations in Hucke-Gaete (2000) in Appendix 1.

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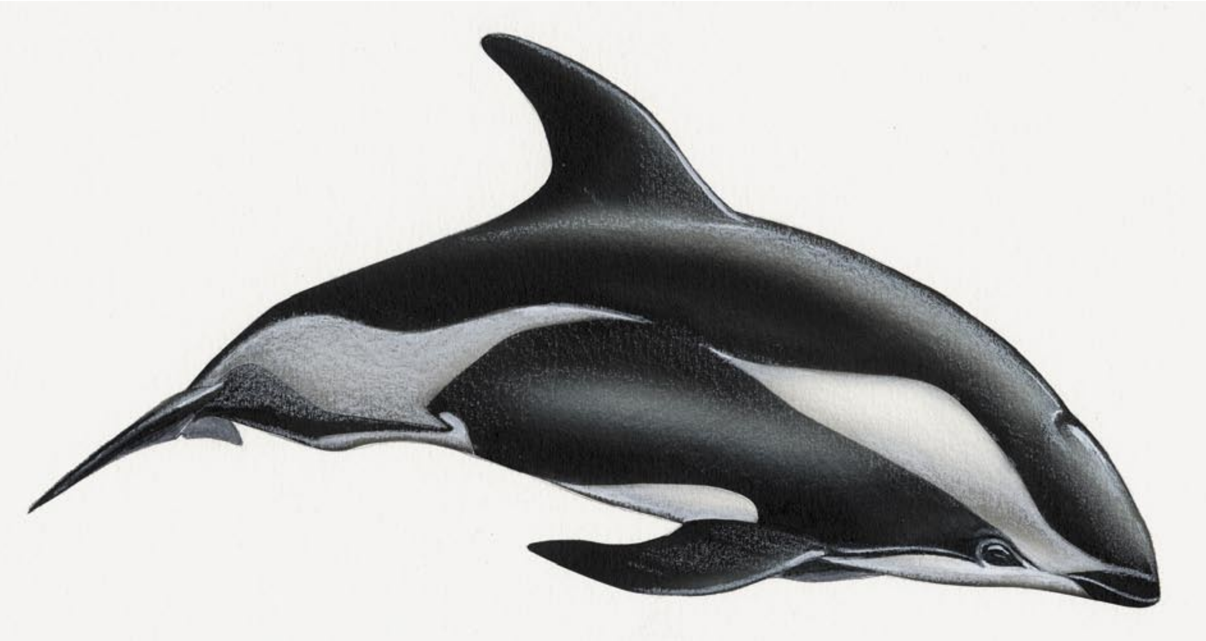
5.25 Lagenorhynchus cruciger (Quoy & Gaimard, 1824)

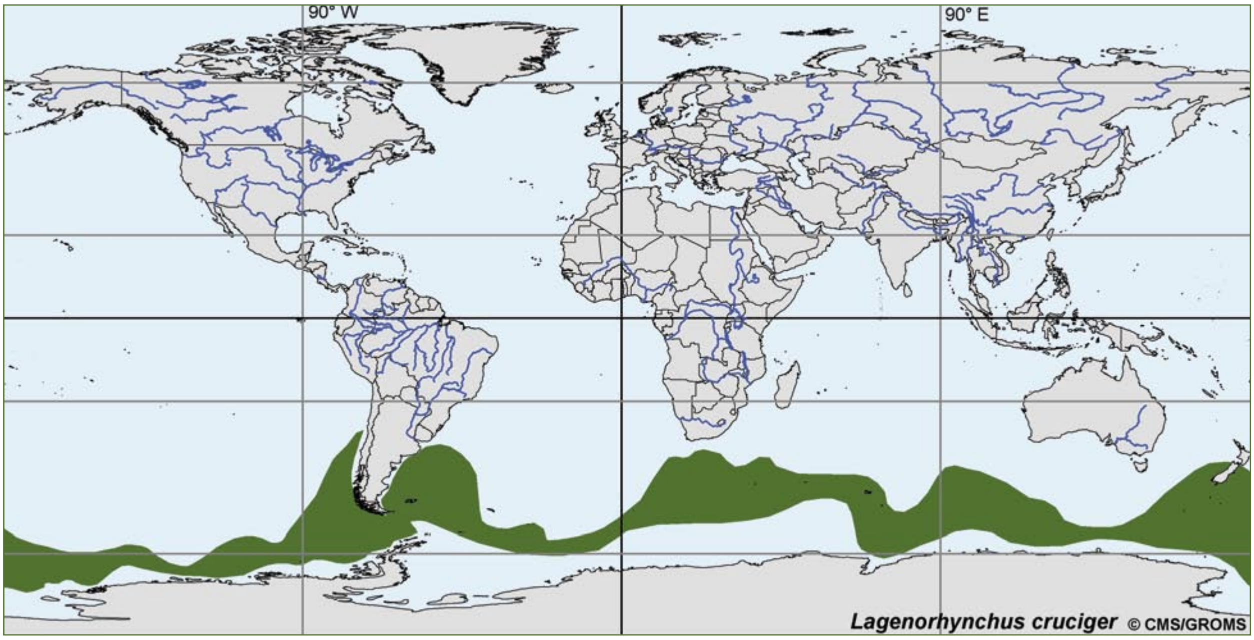
English: Hourglass dolphin
German: Stundenglas-Delphin
Spanish: Delfín cruzado
French: Dauphin crucigère



Drawing of Lagenorhynchus cruciger © Wurtz-Artescienza.

1. Description

Hourglass dolphins are rather stocky, with a large, re-curved dorsal fin. The tail stock is often keeled. Body length ranges from 142-187 cm, and males and females are of equal size. Colouration is mainly black or dark with two elongated white areas, in some animals joined with a fine white line, giving it its common name. The forward patch extends onto the face above the eye. Only 3 specimens were collected until 1960 and the knowledge of the biology of this species rests on a total of 20 specimens (Goodall, 2002).



Distribution of Lagenorhynchus cruciger: cold waters of the Southern Hemisphere, predominantly between 45° and 65°S (mod. from Goodall, 2002; © CMS/GROMS).

2. Distribution

The hourglass dolphin is the only small delphinid that is commonly observed south of the Antarctic Convergence. It is probably circumpolar in pelagic waters of the Subantarctic and Antarctic zones, south of the Subtropical Convergence; most records fall between 45°S and 65°S (Rice, 1998).

The distribution of *L. cruciger* is poorly known, though the range appears to be fairly extensive. It mostly occurs in the South Atlantic and South Pacific, and in cool currents associated with the West-wind Drift. The northern limits are largely unknown, but probably below 45°S. The range probably shifts north and south with the seasons (Carwardine, 1995). In the South Atlantic, there are no sightings south-east of the Antarctic Peninsula: The largest concentration of sightings was in the Drake Passage, an area with considerable ship traffic in summer (Goodall, 1997). Single records as far north as Valparaiso, off the coast of Chile at 33° 40'S, 74° 55'W and at 36° in the South Atlantic seem to be exceptional (Carwardine, 1995; Goodall, 2002). The southernmost sighting is 67°38'S, 179° 57 'E in the South Pacific (Brownell and Donahue, 1999 and refs. therein; Goodall, 1997).

3. Population size

Kasamatsu and Joyce (1995) combined data gathered in sighting surveys conducted from 1976/77 to 1987/88 to produce an abundance estimate of 144,300 for waters south of the Antarctic Convergence.

4. Biology and Behaviour

Habitat: Normally seen far out to sea, but *L. cruciger* has also been observed in fairly shallow water near the Antarctic Peninsula and off southern South America. It occurs within 160 km of the ice edge in some areas in the southern part of its range (Carwardine, 1995; Jefferson et al. 1993). Most sightings of these dolphins are in an area north and south of the Antarctic Convergence between South America and Macquarie Island. The species seems to prefer surface water temperatures between 0.6°-13°C (mean 4.8°C; Goodall, 1997) or even down to -0.3°C (Goodall 2002). Although oceanic, sightings are often near islands and banks. High observer effort, i.e. in the Drake Passage, reflected in high sighting rates (Goodall 2002).

Behaviour: This is a boisterous swimmer capable of speeds exceeding 12 knots. It rides bow-waves and stern-waves of fast boats and ships, swimming with long, low, leaps. From a distance, this undulating motion makes it look like a swimming penguin. It will also swim alongside slow vessels. When swimming fast, hourglass dolphins may travel very close to the surface, without actually leaving the water, creating a great deal of spray when rising to breathe (Carwardine, 1995).

Schooling: Groups tend to be small, which is unusual for a small oceanic delphinid. Although herds of up to 100 have been seen, groups of 1 to 14 are more common (Brownell and Donahue, 1999 and refs. therein). Hourglass dolphins have been encountered with several other species of cetaceans, and may associate with Fin Whales, Sei Whales, Southern Bottlenose Whales, Arnoux's Beaked Whales, Killer Whales, Long-finned Pilot Whales, and Southern Rightwhale Dolphins (Carwardine, 1995).

Food: Prefers fish (e.g. the myctophid *Krefftichtys andersonii*), squid (*Onychoteuthidae* and *Enoploteuthidae*) and crustaceans. Feeding often takes place in large aggregations of sea birds and other cetaceans and in plankton and krill slicks (Goodall et al. 1997; Goodall, 2002; Reid et al. 2000).

5. Migration

Goodall (1997) reports that in the South American sector of the Antarctic and Subantarctic there were no sightings from May to September, probably a reflection of observer effort. However, as stated above, the range may vary according to season and extend further north in winter.

6. Threats

Direct catch: It is likely that their numbers are at or near original levels. There has never been any systematic exploitation (Jefferson et al. 1993). One scientific specimen was collected during commercial whaling operations, and several other specimens have been collected during research cruises (Brownell and Donahue, 1999).

Incidental catch: At least one hourglass dolphin was incidentally caught in an experimental Japanese drift net fishery for squid around 53°13'S, 106°20'W (Brownell and Donahue, 1999). Goodall et al. (1997) and Goodall (2002) report on 4 known casualties in net fisheries in the South Pacific.

Tourism: Increased tourist activity from southern South America to the Antarctic Peninsula should produce increased awareness and further sightings of this species.

7. Remarks

This is a poorly known species with a flexible range, which seems to be influenced in its extent by the seasons. Vagrants off Chile suggest that *L. cruciger* may follow cold currents further North. More information on abundance, area of higher concentrations, home range size, the effect of climate on movements and migrations is needed. For South American populations, see also recommendations in Hucke-Gaete (2000) in Appendix 1.

IUCN and CMS status: "not listed".

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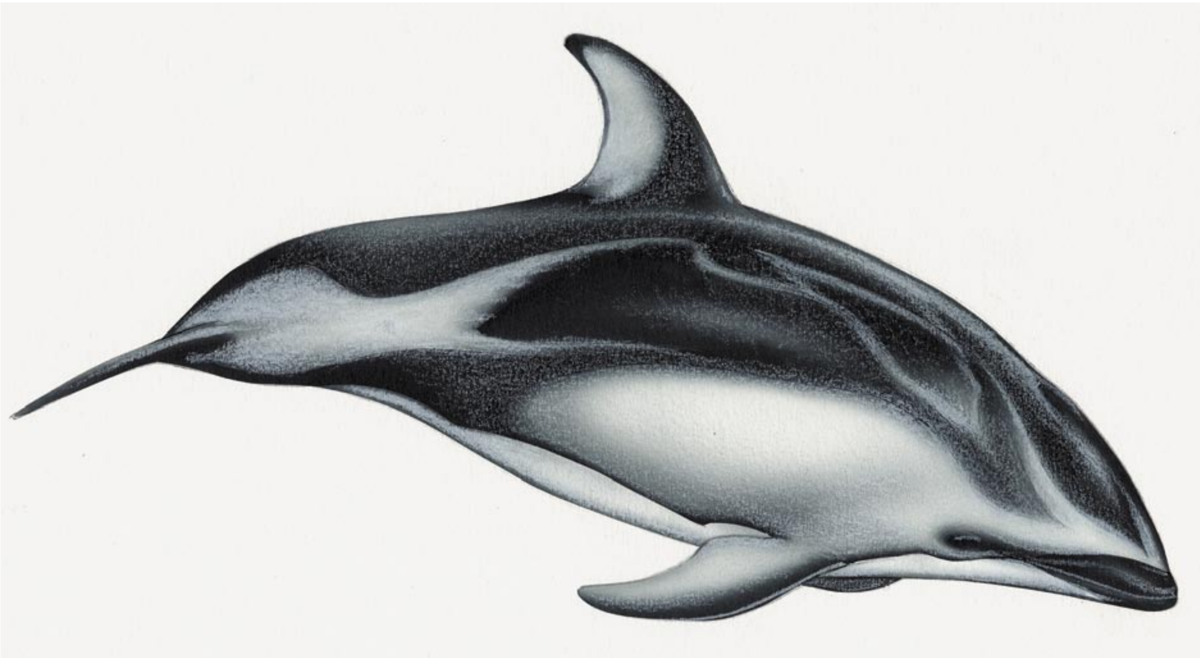
5.26 Lagenorhynchus obliquidens Gill, 1865

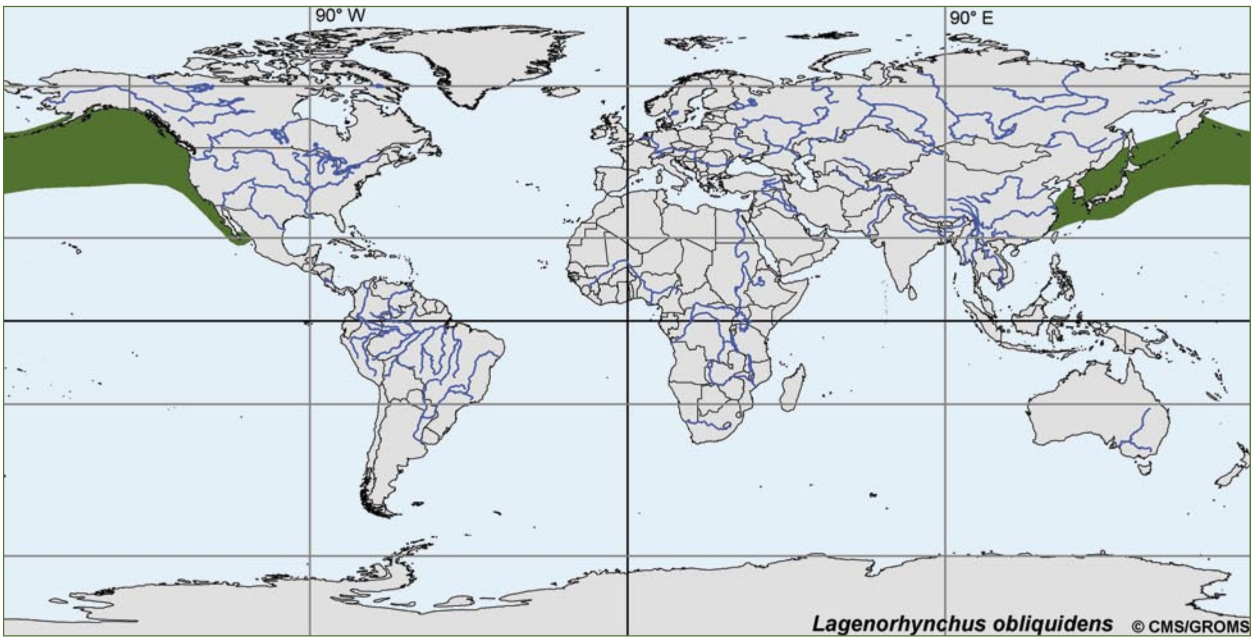
English: Pacific white-sided dolphin
German: Weißstreifendelphin
Spanish: Delfín de costados blancos del Pacífico
French: Dauphin à flancs blancs du Pacifique



Drawing of Lagenorhynchus obliquidens © Wurtz-Artescienza.

1. Description

The boldly coloured Pacific white-sided dolphin is black or dark grey on the back and posterior sides, as well as on the short snout, the leading edge of the tall dorsal fin, and the pointed flippers. The light grey thoracic patch is sharply delineated from the white belly by a thin dark line, in contrast with the dusky dolphin (*L. obscurus*, see page 135) which lacks this line and the sharp demarcation. Grey, linear dorsal flank blazes, often called "suspender stripes", project forward from the grayish flank patches along the back and disappear



Distribution of Lagenorhynchus obliquidens: deep temperate waters of the northern north Pacific, predominantly off-shore (mod. from Brownell et al. 1999; © CMS/GROMS).

above the eyes. Average adult size is 2.1-2.2 m and body mass reaches 75-90 kg (van Waerebeek, 2002).

Close scrutiny of morphological and life history parameters as well as recent cytochrome c sequence analysis supports the premise that *L. obscurus* and *L. obliquidens* are sister species which diverged 1.9-3 million years ago (van Waerebeek, 2002).

Among the North Pacific populations, the animals off Baja California have consistently larger crania than the ones from northern California northward, with intergrading populations occupying the intervening area off southern and central California. Specimens from Korea Strait are on average larger than those from far offshore in the western North Pacific (35°-46°N, 158°-180°E). A tiny proportion of individuals exhibit an alternate colour phase (Rice, 1998, and refs. therein). Lux et al. (1997) found that population-by-population mtDNA comparisons of four geographic strata from the eastern Pacific indicated that all could be considered isolated, but likely incompletely, from one another.

2. Distribution

L. obliquidens is found in the cool temperate waters of the North Pacific. It ranges in the west from the South China Sea northward, throughout Japanese waters, and around the Kuril Islands, extending north to the Commander Islands, and also occurs in the Sea of Japan and in the south-western Okhotsk Sea. In the eastern Pacific, the species occurs primarily in shelf and slope waters from the southern Gulf of California, Mexico along the western coast of North America north to the Gulf of Alaska and as far west as Amchitka in the Aleutian Islands. Across the North Pacific, the species is generally found to have a relatively narrow distribution between 38°N and 47°N (Brownell et al. 1999).

This species tends to remain south of colder waters influenced by arctic currents, and stays north of the tropics (Carwardine, 1995).

Vagrant to Bahia de La Paz in the south-western Golfo de California (Rice, 1998) and infrequently, in the southern Bering Sea (Brownell et al. 1999).

3. Population size

Buckland et at. (1993) estimated the abundance of Pacific white-sided dolphins in the North Pacific at 931,000 animals. This is in close agreement with the estimate of 989,000 by Miyashita (1993). However, precision is low for both studies, and vessel attraction probably resulted in overestimation of population size (Buckland et al. 1999).

For the eastern North Pacific, there are separate abundance estimates for different regions and seasons. Off Oregon and Washington, a peak abundance of 23,400 animals was estimated in May 1992. In February–April 1991 and 1992, aerial surveys conducted along the continental shelf and slope of California resulted in a population estimate of 122,000 (Forney et al. 1995). This contrasts with a ship-based estimate of only 5,900 in August–November 1991 for the same study area (Forney and Barlow, 1998), a discrepancy which may be explained by seasonal migrations (Brownell et al. 1999). Off San Clemente Island, California, Pacific white-sided dolphins were the most abundant of the cold-water species in 1998-99, with a count of 1,649 (Carretta et al. 2000). In the coastal waters of British Columbia, Canada, the Pacific white-sided dolphin is probably the most abundant cetacean (Heise, 1997).

4. Biology and Behaviour

Habitat: *Lagenorhynchus obliquidens* is mainly found offshore, as far as the edge of the continental shelf, but does come closer to shore where there is deep water, such as over submarine canyons (Carwardine, 1995). It is known to occur close to shore in regions such as the inshore passes of Alaska, British Columbia, and Washington, and seasonally off southern California (Brownell et al. 1999, and refs. therein). Ferrero (1998) investigated habitat segregation between various species of small cetaceans in the central North Pacific Ocean. Sea surface temperature was the most influential habitat parameter examined, with *L. borealis* occupying the warmest waters, *P. dalli* the coolest, and *L. obliquidens* in between, but with greater preference overlap with *P. dalli*. Their findings suggest that habitat preference patterns for these three species may be specific to reproductively active females, while coincident habitat use among other species constituents is common.

Behaviour: *L. obliquidens* is very inquisitive and may even approach stationary boats (Carwardine, 1995). It is highly acrobatic and playful, commonly bowriding, and often leaping, flipping, or somersaulting (Jefferson et al. 1993).

Reproduction: Calving apparently occurs during a protracted summer breeding season, which extends into autumn (Jefferson et al. 1993).

Schooling: Often seen in large herds of hundreds or even thousands, these highly gregarious dolphins are also commonly seen with other species, especially northern right whale dolphins and Rissos dolphins (Jefferson et al. 1993) as well as other cetaceans (Brownell et al. 1999). The interspecific relationship with the northern right whale dolphin appears to be a unique association in which large groups of both species are frequently observed to form heterogeneous herds and subgroups. The reason for this close association may be food related, particularly in the oceanic environment as there is considerable overlap in preferred mesopelagic prey (Brownell et al. 1999 and refs. therein). Large schools of Pacific white-sided dolphins may split into smaller groups when feeding, but re-assemble when resting or travelling (Carwardine, 1995).

Food: Pacific white-sided dolphins consume a wide variety of fish and cephalopods. However, considerable differences in feeding preference are evident between animals from coastal and offshore regions. Off British Columbia, Canada, herring (*Clupea harengus*) was the most commonly occurring prey species (59%), followed by salmon (*Oncorhynchus* spp.; 30%), cod (Family Gadidae; 6%), shrimp (Order Decapoda; 3%) and capelin (*Mallotus villosus*; 1%; Heise, 1997). In the North Pacific they feed primarily on epipelagic fish and cephalopods: northern anchovy (*Engraulis mardax*), Pacific hake (*Merluccius productus*), Pacific saury (*Cololabis saira*), juvenile rock fish (*Sebastes* spp., and horse mackerel (*Trachurus symmetricus*). The market squid (*Loligo opalescens*) is also frequently ingested. In the central North Pacific *L. obliquidens* feeds heavily on mesopelagic fish and cephalopods and in coastal waters of northern Japan on both mesopelagic and epipelagic fish and cephalopods (Brownell et al. 1999 and refs. therein).

5. Migration

Some seasonal shifts occur: while more common in coastal waters during fall and winter, *L. obliquidens* move offshore during spring and summer, in rough synchrony with the movements of anchovies and other prey (van Waerebeek, 2002 and refs. therein). Recent seasonal abundance estimates off the entire coast of California are an order of magnitude higher in February–April than in August–November, while peak abundances off Oregon and Washington are observed during May. This pattern strongly suggests seasonal north-south movements of Pacific white-sided dolphins in the eastern North Pacific (Forney and Barlow, 1998). Aurioles et al. (1989) also noted that the species is found seasonally, in spring and summer, in the southwestern Gulf of California. Off San Clemente Island, California, Pacific white-sided dolphins were present only during the cold-water months of November–April (Carretta et al. 2000). Brownell et al. (1999) suggest that the occurrence of the southern form of *L. obliquidens* off Southern California appears to be variable, possibly relating to changes in oceanographic conditions on seasonal or inter-annual time scales (i.e. El Niño events).

In Alaskan waters, published sighting records are sparse, but the occurrence of Pacific white-sided dolphins may be related to periods of warmer waters (Dahlheim and Towell, 1994). Off Japan, Pacific white-sided dolphins occupy the Korean Strait and waters of western Japan in the winter, and appear to move to the east from March to July. Nothing is known about the movements of the two forms described from Japanese coastal waters (Brownell et al. 1999 and refs. therein).

6. Threats

Direct catch: According to Jefferson et al. (1993) Japanese drive and harpoon fisheries take hundreds or even thousands of Pacific white-sided dolphins in most years but Brownell et al. (1999) report that only "small numbers" are taken annually.

Incidental catch: In the eastern Pacific they are occasionally captured in fishing nets, and small numbers are taken in a fishery for live animals (Jefferson et al. 1993). A total of 363 animals were estimated to have been killed in the shark and swordfish drift net fishery in California during the period from April 1988 to December 1995. Additional mortality has been documented for trammel and set nets in California coastal waters, for drift gill nets in British Columbia and Alaska, and for trawl fisheries in Alaska; however, no overall mortality estimates are available for these fisheries. Pacific white-sided dolphins are rarely taken in the tuna purse seine fishery in the eastern tropical Pacific because most of the fishing takes place south of the range of these dolphins (Brownell et al. 1999 and refs. therein).

In the western Pacific, Pacific white-sided dolphins are one of the most commonly caught cetaceans in the Japanese and Korean high seas squid drift net fisheries (Hobbs and Jones, 1993). They were also taken in the Japanese large-mesh and Taiwanese squid and large-mesh fisheries. In 1989, the estimated total by-catch for only the Japanese squid drift net fishery was about 6,100; in 1990, the total estimate for all drift net fisheries combined was 5,759 animals (Hobbs and Jones, 1993). Effort for these fisheries was estimated to have increased during the late 1970s and early 1980s, and then remained relatively stable at least until 1990 (Hobbs and Jones, 1993). In January 1993 a United Nations moratorium on these high seas drift net fisheries went into effect. Smaller catches (e.g. at least 194 in 1987) are reported from the Japanese land-based salmon drift net fishery. Small numbers are taken yearly in seines, set nets, and trap nets around Japan (Brownell et al. 1999 and refs. therein).

Killing: Japanese government-supported "cull" programmes to control several small cetaceans, including Pacific white-sided dolphins, were initiated during the 1970s. Between 1976 and 1980, which were the peak years of this programme, at least 466 *L. obliquidens* are reported to have been killed (Brownell et al. 1999 and ref. therein).

Pollution: The maximum concentrations of DDT and PCBs reported in the blubber of Pacific white-sided dolphins in Japanese waters were 99 ppm and 71 ppm wet weight, respectively. Organochlorine levels in the blubber of two stranded Pacific whitesided dolphins from Californian waters were 2.08 ppm and 99.5 ppm DDT, and 0.23 ppm and 4.88 ppm PCBs. Overall, pollutant loads for this species appear to be variable (Brownell et al. 1999 and refs. therein).

7. Remarks

The Pacific white-sided dolphin is a migratory species which crosses the boundaries of several countries on the east and west coasts of the Pacific Ocean. Range states include Mexico, the US, Canada, Russia, Japan, Taiwan, Korea and China. It should be included in Appendix II of the CMS.

Abundance estimates and biological data are scarce and scientific programmes aimed at the investigation of the behaviour at sea should be encouraged.

IUCN Status: "not listed". CMS status: "not listed".

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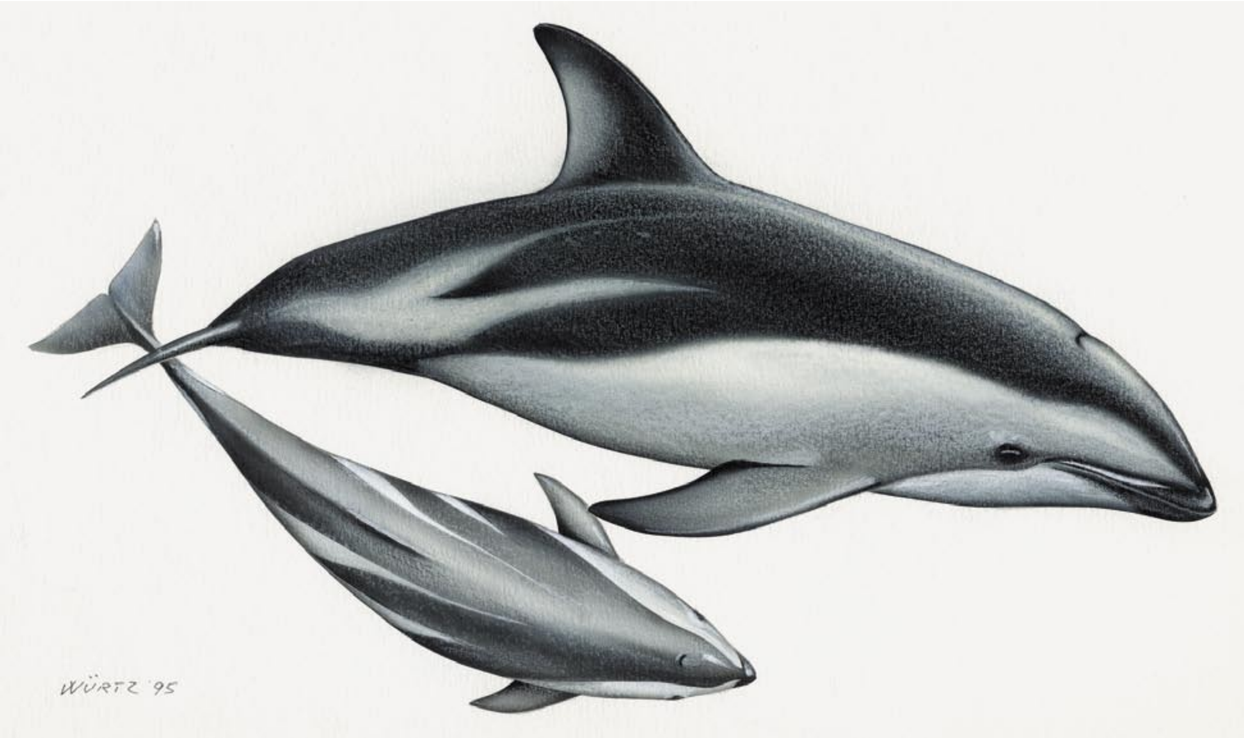
5.27 Lagenorhynchus obscurus (Gray, 1828)

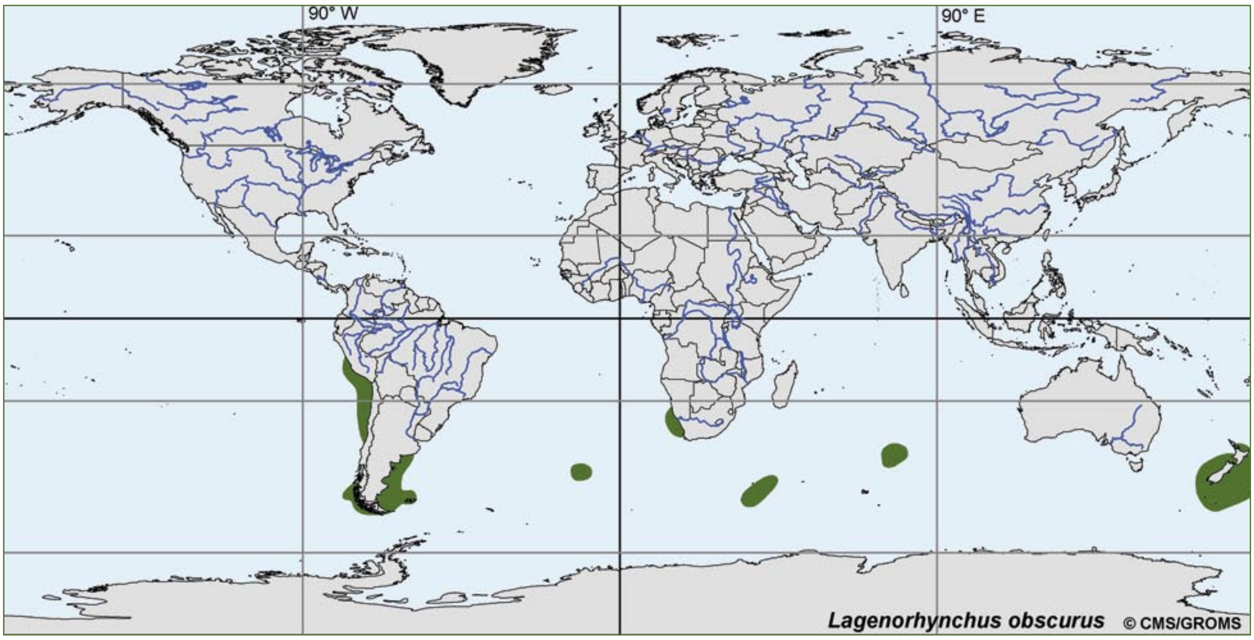
English: Dusky dolphin
German: Schwarzdelphin
Spanish: Delfín oscuro
French: Dauphin sombre



Drawing of Lagenorhynchus obscurus © Wurtz-Artescienza.

1. Description

The largest dusky dolphin males and females reach 211 and 205 cm, respectively, attaining a body mass of rarely higher than 100 kg (van Waerebeek, 2002). Dusky dolphins have virtually no beak, as the head slopes evenly down from the blowhole to the tip of the snout. The tip of the dorsal fin is rather blunt and is



Distribution of the various subspecies of Lagenorhynchus obscurus: coastal temperate waters off New Zealand, Southern Africa and South America (mod. from Brownell and Cipriano, 1999; © CMS/GROMS).

not markedly hooked. A dusky dolphin has a bluish-black tail and back. A dark band runs diagonally across the flanks from below the dorsal fin towards the vent and along the tailstock. The underside of the body is white, and whitish-grey colour extends over the flanks. The tips of the snout and lower jaw are dark. A grey area extends from the eye down to the flipper. Two diagonal whitish streaks run forward from the tail up past the base of the dorsal fin (Baker, 1990).

2. Distribution

Lagenorhynchus obscurus is widespread in the southern hemisphere, but its distribution is probably not continuous. Populations in the South American, African, and New Zealand sectors of the range are sufficiently distinct to be regarded as subspecies, according to Van Waerebeek et al. (1993), although he did not apply scientific names to them (Rice, 1998):

L. o. fitzroyi (Waterhouse, 1838): Ranges in coastal waters of South America from Isla Mazorca, Peru, and Mar del Plata, Argentina, south to the Estrecho de Magallanes; Falkland Islands / Islas Malvinas; animals of undetermined subspecies occur around Gough Island in the South Atlantic Ocean (Rice, 1998). This is a heavily melanized form of *L. o. obscurus* (van Waerebeek, 2002).

The northernmost record *L. obscurus* in Argentina was La Lucila del Mar, north of Buenos Aires Province (36° 19'S), and the southernmost record was at Bahia Nassau (55°26'S, 67°18'W), near Cape Horn (Crespo et al. 1997). It is the most common dolphin species on the Patagonian Shelf (Schiavini et al. 1999). Dusky and Peale's dolphin are mostly sympatric (Goodall et al. 1997). Yazdi (2002) reports of a possible hybrid between a dusky dolphin and a southern right whale dolphin (*Lissodelphis peronii*), south of Peninsula Valdés in Golfo Nuevo, Argentina. In Chile, it is an infrequent visitor south of Valparaiso (Carwardine, 1995).

L. o. obscurus: lives in coastal waters of southern Africa from Lobito in Angola south to Cape Agulhas in Cape Province. It has been reported from Prince Edward Islands (subspecies?) and Ile Amsterdam (subspecies?). Purported sightings and specimens from Iles Crozet and Iles Kerguelen are erroneous or unverified (Rice, 1998).

L. o. subsp.: Ranges on the east coast of New Zealand from Whitianga on North Island south to Stewart Island and is also found on Campbell, Auckland and Chatham Islands (Rice, 1998).

Gill et al. (2000) report the sighting of a school of 15 dusky dolphins off eastern Tasmania, suggesting that the species does, in fact, also occur in Australian waters (not shown on the map). However, The low rates of observation or stranding, compared to those of other inshore dolphins such as *Delphinus delphis*, which is well-known along the southern Australian coast, strongly suggest that dusky dolphins occur rarely in coastal waters of southern Australia and are unlikely to be resident. Dusky dolphins may occur far offshore, visiting coastal waters in response to unusual oceanographic conditions. Another possibility is that members of the population around St Paul and Amsterdam Islands may visit Australian waters (Gill et al. 2000).

3. Population size

Little information is available on the abundance of *L. obscurus* throughout its range. During the Southern Hemisphere minke whale assessment cruises between 1978/79 and 1987/88, a total of 2,665 dusky dolphins in 27 schools were observed. These observations were made while in transit between home ports and the Antarctic, but no abundance estimates were calculated (Brownell and Cipriano, 1999 and refs. therein). The total number of dusky dolphins in the fishing area off the Patagonian cost was recently estimated to be close to 7,252 individuals (Dans et al. 1997), and the number given by Schiavini et al. (1999) for the area between Punta Ninfas and Cabo Blanco, Argentina is 6,628. Off the Peruvian coast, dusky dolphins were the third most abundant cetacean species sighted (Sanchez et al. 1998).

4. Biology and Behaviour

Habitat: This coastal species is usually found over the continental shelf and slope (Jefferson et al. 1993; Aguayo et al. 1998). The distribution of dusky dolphins along the west coast of South Africa and both coasts of South America is associated with the continental shelves and cool waters of the Benguela, Humboldt and Falkland Currents. Around New Zealand these dolphins are associated mainly with various cold water currents (Brownell and Cipriano, 1999). Van Waerebeek et al. (1995) suggest that dusky dolphins may be limited to water shallower than 200 m. Off Argentina, dusky dolphins have been sighted from the coast to just before the 200 nautical miles Exclusive Economic Zone border, but the present information does not us allow to conclude whether this species' distribution tends to be more coastal than offshore or vice versa due to the bias in coastal effort (Crespo et al. 1997). They seem to prefer waters with sea surface temperatures between 10°C and 18°C (Brownell and Cipriano, 1999).

Behaviour: Dusky dolphins are highly inquisitive and usually easy to approach. They seem to enjoy the contact with boats and people and readily bow-ride (Carwardine, 1995). Dusky dolphins are one of the most acrobatic of dolphins, frequently leaping high out of the water, at times tumbling in the air (Jefferson et al. 1993). Mean dive time for 10 radio tagged dolphins off Argentina was only 21.0 sec, and the number of long dives (>90 sec), probably associated with feeding, peaked in mid-day to afternoon in summer (Würsig, 1982). Subgroups of dusky dolphins within larger schools off New Zealand sometimes were observed to dive synchronously, and occasionally almost the entire group would be underwater for several minutes (Brownell and Cipriano, 1999 and refs. therein).

Schooling: The dusky dolphin is highly gregarious and seems to welcome the company of other species as well as its own: it is often seen with seabirds and frequently associates with other cetaceans. Its own group sizes vary according to the time of year, with larger numbers living together during the summer (Carwardine, 1995). School size is fairly variable, with a range of 2-500 and a mean school size of 98.7 individuals. During the winter months, groups with less than 20 individuals are more common than at other times of the year. Stable subgroups were observed within a more fluid society of changing group size (Würsig and Würsig, 1980) and probably displayed a high degree of individual-to-individual fidelity (Würsig and Bastida, 1986).

In Argentine dusky dolphins, large groups are more efficient at herding schools of anchovy than small ones, and it appears that methods for calling in distant groups evolved because the food benefit for each dolphin is increased when groups join forces. Cooperative herding appears essential to Argentine dusky dolphins in their effort to feed on small schooling fish. An original group of eight to 10 dolphins often increases to more than 200 by the time feeding is completed. After they have fed, high levels of social and sexual activity take place in the large group (Würsig et al. 1989).

Off Argentina, fishermen detected schools of >50 individuals, mostly between noon and 1600-hrs, while the schools sighted from aeroplanes were of <20 individuals (Crespo et al. 1997). The mean school size calculated for aerial surveys was 3.85 individuals, considerably lower than previously published information (6-15 individuals).

In New Zealand, the feeding and social behavior of dusky dolphins are very different. Instead of traveling, as their Argentine kin do, in a widespread school with small groups some distance apart, New Zealand duskies move in closely knit schools, made up of subgroups of about ten individuals. There is usually an unbroken and tight perimeter surrounding an entire school so that two- or three hundred animals cover an area generally no larger than one square kilometer. The entire school travels in search of food as a directed unit rather than meandering in groups. Like the duskies of Argentina, they split into small groups to rest near shore during the day (Würsig et al. 1989).

School size of dusky dolphins off Kaikoura, New Zealand ranged between 2-1,000, and varied seasonally, with mean school size between 50-100 in spring, summer and fall and between 150-175 in winter months (Cipriano 1992).

Dusky dolphins have been observed in mixed cetacean schools with southern right whale dolphins (*Lissodelphis peronii*) off Namibia. In summer, *L. obscurus* groups off Kaikoura, New Zealand were occasionally accompanied by small groups of common dolphins (*Delphinus delphis*), which travelled as a cohesive subgroup within the larger dusky dolphin group. Dusky dolphins were also observed with pilot whales (*Globicephala* sp.) off Southwest Africa and the Prince Edward Islands (Brownell and Cipriano, 1999, and refs. therein). Off Argentina, dusky dophins were als o observed in association with 2 *Delphinus capensis* females and one *Tursiops truncatus* male (Yazdi, 2000).

Reproduction: In New Zealand and Argentina, calving is believed to peak in summer (November to February; Jefferson et al. 1993). In Peruvian waters most births ocurred in late winter (August, September, and October; Waerebeek & Read, 1994).

Food: *L. obscurus* take a wide variety of prey, including southern anchovy and mid-water and benthic prey, such as squid and lanternfishes. They may also engage in nocturnal feeding. Co-operative feeding is practised commonly in some areas (Jefferson et al. 1993).

The most important prey of the dusky dolphin in Peruvian coastal waters was Anchoveta (*Engraulis ringens*). It constituted almost 90% of the dusky dolphinh´s diet by percent gross energy (Mc Kinnon 1994). Other prey species commonly found in dolphin stomachs were horse mackerel (*Trachurus symmetricus*), hake (*Merluccius gayi*), sardine (*Sardinops sagax*), Patagonian squid (*Loligo gahi*) and jumbo flying squid (*Dosidicas gigas*) (Mc Kinnon, 1994).

The most important prey of Patagonian dusky dolphins between 42°S and 46°30'S in Argentina was the southern anchovy (*Engraulis anchoita*), representing 39% of prey by number, 46% by weight (Koen Alonso et al. 1998). The most frequent prey was the patagonian squid (*Loligo gahi*), which was present in 84% of stomachs. Other prey species found were hake (*Merluccius hubbsi*), the "pampanito" (*Stromateus brasiliensis*), the southern cod (*Nothotenia* sp.), shortfin squid (*Illex argentinus*), the sepiolid (*Semirossia tenera*) and the octupus (*Octupus tehuelches*).

Stomachs from 24 dusky dolphins incidentally killed in fishing operations in New Zealand waters contained remains of mesopelagic fishes, mainly myctophids and Hoki (*Macruronus novaezelandiae*), and squids (*Nototodarus* spp., *Moroteuthopsis* spp. and *Teuthowenia* spp.; McKinnon, 1994; Brownell and Cipriano, 1999).

5. Migration

The Argentinian and New Zealand populations exhibit inshore-offshore movements both on a diurnal and on a seasonal scale (van Waerebeek, 2002). They were found during most of the year in Golfo San José, Argentina, with a seasonal low in abundance during winter and a peak in summer (Würsig and Würsig, 1980). In summer, these dolphins were also found more often in deeper water near the mouth of the bay, at a time when southern anchovy (*Engraulis anchoita*) is probably moving into deeper water.

In the Kaikoura area off South Island, schools consisted of 50 to several hundred dolphins that usually travelled as a unit, sometimes covering several square kilometres. In summer, the dolphins moved from nearshore to offshore waters during the course of the day, apparently feeding on mesopelagic fishes in deep water during evening and night but consistently remained closer to shore than during winter months (Brownell and Cipriano, 1999 and refs. therein). Off the west coast of New Zealand's South Island, dusky dolphins occurred almost exclusively in summer in groups of 2-150 individuals, often with calves, especially at Cape Foulwind and Jackson Head (Braeger and Schneider, 1998).

These animals may cover large distances. Würsig and Bastida (1986) equipped two dusky dolphins with spaghetti tags in Jan. 1975 off Golfo San José Argentina. One and five days after tagging, the two dolphins were sighted approximately 20 km and 35 km from the tagging site, respectively. On 1 December 1982, both dolphins were observed swimming side by side in a school of approximately 150 dusky dolphins about 10-km off Mar del Plata, approximately 780 km northeast of the original tagging location.

The intermittent nature of 12 records in Tasmania over 175 years is puzzling. Setting aside concerns about identification, the dates of records are quite seasonal, occurring from October/November (8) through January (1) and March/April (3). Such seasonality suggests a causal link with changes in one or more oceanographic features in this region, perhaps, for example, in the position of the Subtropical Convergence, a feature which appears to coincide with the northern limit of distribution for this species off eastern New Zealand, and/or ENSO events (Gill et al. 2000).

6. Threats

Direct catch: An expanded directed fishery for dolphins and porpoises may have started in Peru after the demise of the anchoveta fishery in 1972. Although most dusky dolphins are taken in the directed net fishery they are also taken by a harpoon fishery (Brownell and Cipriano, 1999 and refs. therein). It has been calculated that the fishing industry from just one port kills more than 700 dusky dolphins each year. These dolphins are sold for food, so they are taken incidentally and as deliberate targets (Jefferson et al. 1993). Large catches (approximately 10,000) of small cetaceans were reported from the coastal waters of central Peru in 1985 (Read et al., 1988). In the 1991–1993 period, an estimated 7,000 dusky dolphins were captured per year, an exploitation thought to be unsustainable. It is believed, but not confirmed, that this level of exploitation has dimished since dolphin hunting was banned by law in 1996 and due to depletion of the population (van Waerebeek, 2002). Around a thousand dolphins and other small whales are still falling victim annually to fishermen to supply bait meat for the shark fishery (2003, see mundo azul in "selected web-sites").

Incidental catch: In New Zealand, some dusky dolphins are entangled in gill nets. Incidental mortality at one fishing port was estimated to be 100 to 200 animals per year (Jefferson et al. 1993).

The highest rates of incidental catches off the Patagonian coast mostly occur in mid-water trawling for shrimp. At present, this fishery is declining in use, but in 1984, it reached a peak and the number of dolphins caught was estimated at between 442–560, decreasing during the following years. Mortality estimates for 1994 reached a minimum value of 36 dolphins per year, mostly females and young matures. Half of the females were mature and half of these were pregnant. Thus, incidental mortality during 1984-86, would have led to a maximum annual mortality close to 8 % of the present estimated population size. The effect on the population would have been severe considering that the catches affected mostly females of the highest reproductive value (Dans et al. 1997).

Of 722 cetaceans captured mostly in multi-filament gillnets and landed at Cerro Azul, central Peru, in 87 days during January-August 1994, 82.7 % were dusky dolphins. The total kill estimate for a seven-month period, stratified by month, was 1,567 cetaceans. Data collected at 16 other ports showed that high levels of dolphin and porpoise mortality persisted in coastal Peru at least until August 1994 when an unimplemented 1990 ban on small cetacean exploitation was renewed. Circumstantial evidence suggests that, thereafter, increasing enforcement reduced direct takes and illegal trade in meat but also hampered monitoring. The absence of abundance data precludes any assessment of impact on populations (van Waerebeek et al. 1997).

Pollution: The maximum concentration (ppm wet weight) of DDT reported in the blubber of this species in New Zealand waters was 175 (Brownell and Cipriano, 1999 and refs. therein).

Tourism: Commercial dolphin watching and swim-with-dolphin operations started in the late 1980s and are a major industry in Kaikoura, New Zealand. During summer, boats approach the same dolphin groups throughout the day. While there are behavioural reactions by the dolphins, no large-scale or long-term adverse reactions to human tourism have been documented to date. It is presently unknown whether more subtle chronic effects could be detrimental to the population (Würsig et al. 1997).

7. Remarks

Genetic analyses indicate that the genus *Lagenorhynchus* is more diverse than had been believed from morphological studies. The genus is likely a paraphyletic assemblage of species in need of taxonomic revision. Population definitions and numbers are unknown for New Zealand and other areas and intensive photo-identification, genetic and survey studies are recommended.

Bycatch in gillnets occurs at an unknown level and needs to be investigated. Long-term data are needed on human tourism effects. No recent data exist on bio-accumulated pollutant levels in dusky dolphins and this avenue of research is also seen as important (Würsig et al. 1997). For South American stocks, see recommendations in the Hucke-Gaete (2000) report in Appendix 1.

Range states include Peru, Chile, Argentina, Great Britain (Falkland / Malvinas Islands), South Africa, France (Amsterdam Islands), and New Zealand.

IUCN Status: "Data Deficient". *L. obscurus* is included in Appendix II of CMS.

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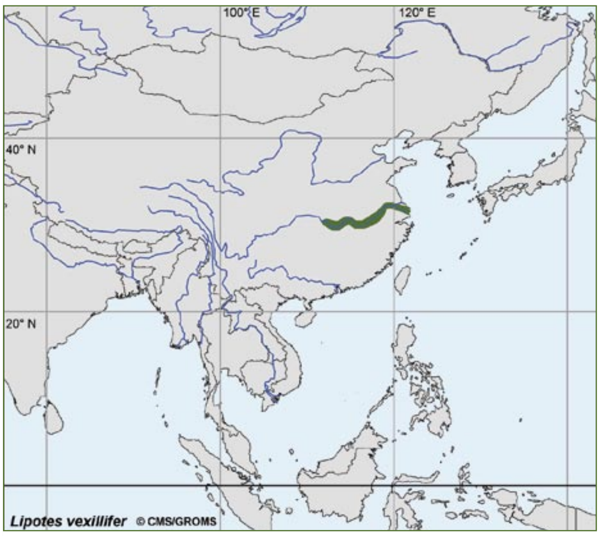
5.28 Lipotes vexillifer (Miller, 1918)

English: Yangtse river-dolphin; baiji; whitefin dolphin
German: Chinesischer Flußdelphin
Spanish: Baiji; Delfín de China
French: Baiji; Dauphin fluviatile de Chine

Drawing of Lipotes vexillifer © Wurtz-Artescienza.

1. Description

The Baiji is the rarest and most endangered cetacean in the world. It is a very graceful animal, with a very long, narrow and slightly upturned beak. Baiji's can easily be identified by the rounded melon, longitudinally oval blowhole, very small eyes, low triangular dorsal fin and broad, rounded flippers. The coloration is blueish-grey to grey above and white to ashy-white below. Females are larger than males, reaching 253 cm as opposed to 229 cm in males (Zhou, 2002).



Map of the Chang Jiang (Yangtse River) showing the distribution of Lipotes vexilifer in the 1980's (mod. from Zhou, 2002; © CMS/GROMS).

2. Distribution

The Baiji is an exclusively freshwater species and ranges in the lower and middle reaches of the Chang Jiang (Yangtse River), from its estuary upstream for 1,60 km as far as the gorges above Yichang (20 m above sea level). At least one record was reported from the lower Fuchun Jiang at Tonglu (Rice, 1998). Individuals might enter some tributary lakes during intense flooding (Zhou, 2002).

3. Population size

Zhou et al. (1998) report on boat surveys conducted along a 500 km section of the Yangtze River between Zhenjiang and Hukou in 1989-1991. Seven individual baiji were photographically identified in 84 photographs based on natural markings. There were 7 sightings of baiji in May 1989, 4 sightings in March 1990 and 6 sightings in April-May 1990, resulting in total counts of 9, 7 and 11 individuals respectively. Estimated population size was about 30 individuals in the 500 km river study area.

Zhou et al. (1998) emphasise that if the baiji still inhabits its historical 1,700 km range in the Yangtse River, and population density is similar throughout this habitat section, there may only be 100 baiji remaining in the river. Concentration of manpower and resources to speed up the completion of semi-natural reserve projects are urgently needed if baiji are to survive beyond the start of the 21st century.

Results of recent surveys of almost all the species' previous range, Shanghai to Yichang, suggest that the population is very small and is still declining. In 1998 only a few dozen animals may have still been alive (Zhou, 2002).

In Dongting Lake and Boyang Lake, Baijis became extinct by 1999 (Yang et al. 2000).

Zhang et al. (2003) report that Baiji were sighted 18 times during three recent simultaneous multi-vessel surveys in the Yangtze River, China (November 4–10, 1997; December 4–9, 1998; October 31– November 5, 1999). There were 11 sightings in 1997 (consisting of 17 animals), five in 1998 (seven animals), and two in 1999 (four animals). It was concluded that 13 individuals could be considered as a minimum number of the baiji currently in the Yangtse River. The annual rate of population decrease was roughly estimated as 10 %. The present distribution range of the baiji is less than 1,400 km in length in the Yangtse main river. Distances between the two nearest groups of baiji appear to be increasing.

4. Biology and Behaviour

Habitat: Baiji are generally found in eddy countercurrents below meanders and channel convergences. The Yangtse River is turbid and visibility from the surface downward is about 25–35 cm in April and 12 cm in August. Baiji eyes are correspondingly reduced, much smaller than those of other dolphinids and placed higher on the head. However, they are functional and Baiji's will distinguish objects placed on the surface (Zhou, 2002). Zhang et al. (2003) report that Baiji showed a significant attraction to confluences and sand bars with large eddies.

Schooling: They generally live in small groups of 3–4 animals, largest observed group size being 16 animals (Zhou, 2002). Two typical sightings are described (Zhang et al. 2003), in which surfacing and movements of baiji were recorded. Baiji were often found swimming together with finnless porpoises. In the surveys they occurred in the same group in 63 % of occurrences.

Behaviour: Baijis will surface without splashing and breathe smoothly. Short breathing intervals of 10–30 s alternate with a longer one of up to 200-s (Zhou, 2002).

Reproduction: The baiji probably breeds and gives birth in the first half of the year. The peak calving season appears to be February to April (Zhou, 2002).

Food: Any available species of freswhater fish is taken, the only selection criterion appears to be size (Zhou, 2002).

5. Migration

Reyes (1991) classified the species as "non-migratory". Peixun (1989) reports of movements within home ranges, but not on migratory behaviour.

Baiji may also make long-range movements. Hua et al. (1994) recorded a single individual moving more than 300 km from March 1989 to January 1992, implying that the baiji's distribution range may be dynamic. Anecdotal information from fishermen in the river during the surveys indicated that baiji move upstream when water rises in the spring and downstream when water recedes in winter (Zhang et al. 2003).

Zhou et al. (1998) showed from photographic identifications and sighting records that baiji groups made both local and long-range movements. The largest recorded range of a recognisable baiji was 200+ km from the initial sighting location.

6. Threats

The Yangtse is suffering massive habitat degradation:

- The banks of the river have been modified extensively to prevent destructive flooding of agricultural areas, thus reducing the floodplain area (Zhou, 2002). Future projects such as a series of flood-preventing and controlling projects along the middle and lower reaches of the Yangtse River have been examined critically: Mainly two kinds of impacts, during construction, and through environment and habitat changes are expected. The projects of cutting off Paizhouwan Oxbow and of setting up a water gate at the mouth of Lake Poyang will cause huge influence on the baiji and the finless porpoise (*Neophocaena phocaenoides*) (Zhang et al. 2001).

- Wastewater volume discharged into the Yangtze is about 15.6 billion cubic meters per year. Approximately 80 % of these wastewaters are discharged directly into the environment without treatment (Zhou, 2002).

- Dudgeon (1995) reports that in the Zhujiang, dam construction has caused reductions in fisheries stocks but here, as elsewhere in China, the ecologically damaging consequences of river regulation are exacerbated by overfishing and increasing pollution of rivers by sewage, pesticides and industrial wastes. Furthermore, large-scale water-transfer projects and the planned construction of the largest dam in the world (the Three Gorges High Dam) on the Chang Jiang will have a series of potential effects on the environment. These plans will affect fish stocks, alter inundation patterns in wetlands of international conservation significance and may contribute to the extinction of the baiji.

- In addition, deforestation and soil erosion in the Chang Jiang basin have given rise to siltation and degradation of floodplain habitats (Dudgeon, 1995).

As summarized by Zhou (2002), the threats faced by the baiji include river traffic, fishing gear, reduction of fish stocks, and water pollution. Unfortunately, these massive threats are continuing and appear to become rapidly more serious.

Finally, Rosel and Reeves (2000) point out another, equally threatening effect: These animals face an additional suite of potentially serious problems that are often overlooked, perhaps because they are not so obvious. The genetic and demographic consequences associated with very small population size can result in extinction even when effective measures are in place to protect the animals and their habitat. Small populations tend to harbor less genetic variation than large populations. In addition, small populations are more strongly affected by processes of genetic drift and inbreeding, both of which can further reduce genetic variability. Genetically depauperate populations may have lower fitness, a reduced ability to adapt to changes in their environment over time, and decreased evolutionary potential. Finally, small populations may also be more vulnerable to demographic stochasticity, which can accelerate the process of extinction. Awareness of the genetic and demographic consequences of small population size should be integral to planning for conservation of endangered river cetacean species and populations.

7. Remarks

Huan and Chen reported as early as 1992 that "the distribution density of Baiji in the river section of Ouchikou-Chenglingji (158 kilometres) was gradually diminishing. Its distribution density in the section under research diminished from 3.67 km/per dolphin in 1986 to 10.36 km/per dolphin in 1991. The Baiji has been listed as first-class animal under the protection of the Chinese Government, but its population size decreases further and human activities still severely endanger its existence. With further human exploitation of the Yangtse River, new key water-control projects will be built. Hence, a conservation strategy must be adopted to rescue this species."

The IUCN lists the species as "critically endangered" (CR A1bc, C2b, D). This is due to an observed population reduction in the form of either of the following: A) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying): b) an index of abundance appropriate for the taxon; c) a decline in area of occupancy, extent of occurrence and/or quality of habitat. C) Population estimated to number less than 250 mature individuals and: 2) a continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of: b) all individuals are in a single subpopulation. Finally, D) The population is estimated to number less than 50 mature individuals. *L. vexilifer* is listed in appendices I and II of CITES.

There may be as few as <10 animals left in the wild today. The Conservation Breeding Specialist Group held a PHVA workshop in Nanjing, China, in 1993 in an attempt to rescue the species (see "selected websites"). Wang et al (2000) recommend that in order to conserve finless porpoises in the Yangtze river, the following actions are needed: 1) a breeding group should be established in the Shishou Baiji semi-natural reserve; 2) natural reserves should be established in areas most frequented by the animals; and 3) research on captive breeding should be intensified.

According to Zhang et al. (2003) human activities are the main threats to the baiji. Illegal electrical fishing accounted for 40% of known mortalities during the 1990s. Engineering explosions for maintaining navigation channels have become another main cause of baiji deaths. The last hope of saving the species may be to translocate the remaining baiji into a semi-captive reserve, known as the 'Baiji Semi-natural Reserve'.

Although baiji do not cross international boundaries in their movements and migrations within their home ranges, the species seems to be migratory. Too little is known about their natural behaviour, population size, and remaining habitats maintaining viable populations. Research and rescue efforts should urgently be intensified in order to prevent extinction of this species.

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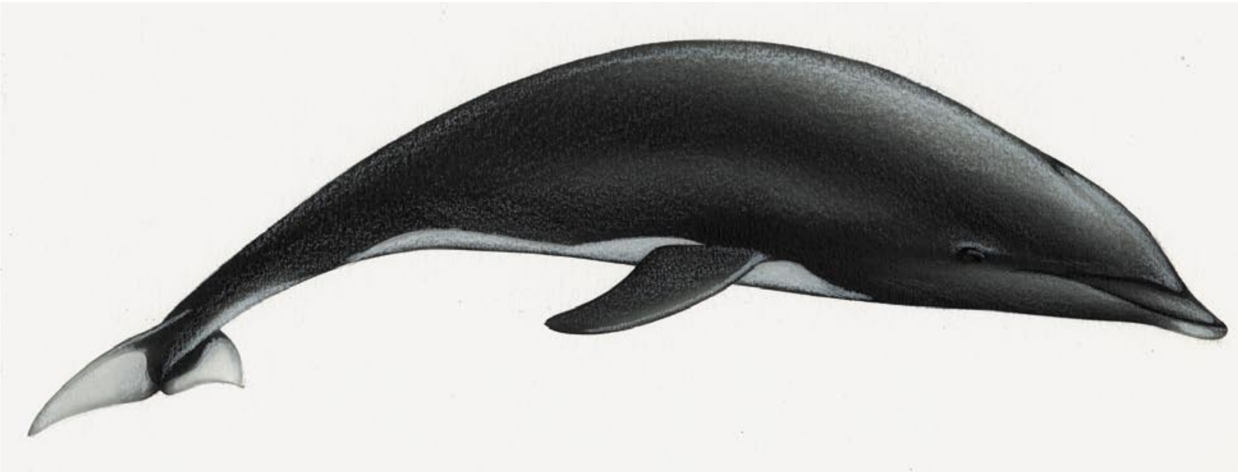
5.29 Lissodelphis borealis (Peale, 1848)

English: Northern right-whale dolphin
German: Nördlicher Glattdelphin
Spanish: Delfín liso del norte
French: Dauphin à dos lisse boréal

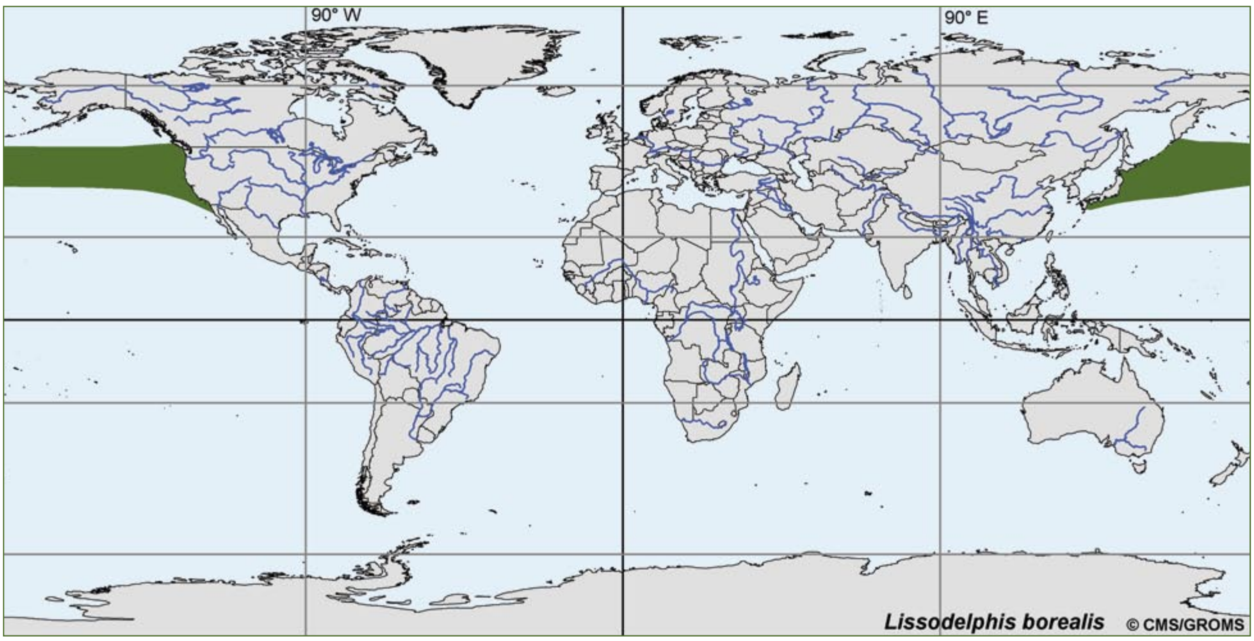


Drawing of Lissodelphis borealis © Wurtz-Artescienza.

1. Description

Right whale dolphins are easy to identify at sea because of their distinctive black and white colour and lack of dorsal fin. The northern right whale dolphin is mainly black with a white ventral patch that runs from the fluke to the throat region. There is a further small white patch on the tip of the rostrum and the undersides of the flippers are also white. Size reaches ca. 3 m, males growing larger than females, and body mass reaches up to 116 kg (Lipsky, 2002).

A few individuals possess an alternate colour pattern with a more extensive white area on the venter. These animals were first referred to the Southern Hemisphere *L. peronii* (see page 151). Later it was decided that they represented a new race of the northern species, *L. b. albiventris*. However, such individuals occur sporadically in schools of normally-patterned *L. borealis* throughout the species' range, and they do not constitute a taxonomically recognisable population (Rice 1998, and refs. therein).



Distribution of Lissodelphis borealis: cool, deep temperate waters of the northern North Pacific (mod. from Lipsky, 2002; © CMS/GROMS).

This is supported by Dizon et al. (1994), who obtained quantitative measures of reproductive isolation between putative populations of *L. borealis* and sequenced a portion of the control region of the mitochondrial DNA (mtDNA) genome in 65 geographically dispersed individuals. No evidence of geographically concordant population structuring was apparent. In addition, a Mantel test, examining pairwise correspondence between geographic and genetic distances among samples, failed to detect any evidence of isolation by distance.

2. Distribution

Lissodelphis borealis ranges in temperate and subarctic waters of the North Pacific, from the Ostrova Kuril'skiye (Kamchatka, Russia) south to the Sanriku coast of Honshu (Japan), thence eastward across the Pacific between 34° and 47°N, extending north to 55°N, 145°W, in the Gulf of Alaska, to the west coast of North America from British Columbia, Canada, to northern Baja California, Mexico (Rice, 1998). There seems to be an area of very low density immediately south of the Aleutian Islands, Alaska, perhaps separating the eastern and western populations (Carwardine, 1995).

Movements beyond the normal range occur occasionally, as evidenced by sightings as far south as 29°S off Baja California, Mexico, and as far north as 59°N in the Gulf of Alaska and just south of the Aleutian Islands in the central Pacific. The northernmost sightings are generally from summer months and the southernmost from winter months (Jefferson et al. 1994 and refs. therein; Carwardine, 1995). *L. borealis* may also occur in the northern Sea of Japan (Carwardine, 1995).

3. Population size

Peak populations of northern right whale dolphins have been estimated at 17,800 off southern California, and at around 61,500 off central and northern California, making them the second or third most abundant cetacean off California, after *Delphinus delphis* and *Lagenorhynchus obliquidens* (Jefferson et al. 1994). Forney et al. (1995) report 21,300 animals from Californian waters in winter/spring. Carretta et al. (2000) counted 754 animals off San Clemente Island during winter. Buckland et al. (1993) counted 68,000 in the North Pacific, whereas Hiramatsu (1993) estimated the entire population there at 400,000.

4. Biology and Behaviour

Behaviour: The animals are easily startled. When fleeing, a group typically gathers in tight formation, with many animals leaping simultaneously, and often working the sea into a froth. They may also swim slowly, causing little disturbance of the water and exposing little of themselves at the surface. Breaching, belly-flopping, side-slapping, and lobtailing are fairly common. They may bow-ride, but usually avoid boats (Carwardine, 1995).

Habitat: Northern right whale dolphins are observed most often in cool, deep, offshore waters over the continental shelf and beyond, with temperatures of 8-9°C. They are sometimes seen near shore, especially where deep water approaches the coast (underwater canyons), and apparently prefer "coastal-type" waters in the California Current system (Jefferson et al. 1994 and refs. therein; Carwardine, 1995). Ferrero (1998) observed in the central North Pacific that sea surface temperature was the most influential habitat parameter examined, *L. borealis* occupying the warmest waters, *P. dalli* the coolest, and *L. obliquidens* in between, but with greater preference overlap with *P. dalli*. Habitat partitioning was best expressed by mature female *L. borealis*, in July, during their calving period. Mature female *L. borealis* associated with a consistent assemblage of other marine organisms during July and August while associations among other species were more varied.

Schooling: Northern right whale dolphins are highly gregarious. They are occasionally seen singly, but more often in groups of up to 2,000-3,000. Average herd sizes are about 100 in the eastern Pacific and 200 or more in the western Pacific (Jefferson et al. 1994 and refs. therein). These groups commonly mix with other marine mammals, especially the Pacific white-sided dolphins, with which they share a nearly identical range (Jefferson et al. 1993). They also associate with pilot whales and Risso's dolphins (Lipsky, 2002). Travelling speed may reach 40 km per hour (Lipsky, 2002).

Reproduction: There appears to be a calving peak in winter to early spring (Jefferson et al. 1993). Iwasaki and Kasuya (1997), however, observed a calving peak between June and August.

Food: Although squid and lanternfish are the major prey items for right whale dolphins off southern California, a variety of surface and mid-water species are taken (Jefferson et al. 1993). Chou et al. (1995) report that stomach contents in two *L. peronii* consisted to 89 % of myctophid fish. Other prey species include hake, saury and mesopelagic fish (Lipsky, 2002 and refs. therein).

5. Migration

Movements south and inshore for winter months and north and offshore for summer months have been reported for both sides of the Pacific. Peak periods of abundance off southern California coincide with peak occurrence there of market squid (*Loligo opalescens*) (Jefferson et al. 1994 and refs. therein).

Forney and Barlow (1998) studied seasonal abundance and distribution of cetaceans within 185-280 km of the California coast during 1991 and 1992. Northern right whale dolphins were significantly more abundant in winter than in summer and significant inshore/offshore differences were identified. In winter northern right whale dolphins were widespread throughout the continental shelf region of the Southern California Bight, but no sightings were made there in summer. During both seasons they were commonly observed off central and northern California, and in summer they were also observed off Southern California near the offshore edge of the study area. This evidence for a winter influx of northern right whale dolphins into shelf waters of the Southern California Bight in 1991-1992 is consistent with similar findings made during the late 1970s. During the summer, some of these animals may be farther offshore (Barlow, 1995). Carretta et al. (2000) found that off San Clemente Island, *L. borealis* were only present between November and April.

6. Threats

Direct catch: In the western Pacific, coastal fisheries off Japan have taken them for many years, with 465 reported killed in the harpoon fishery in 1949. Although this fishery mainly targets other small cetaceans, northern right whale dolphins continue to be taken (Jefferson et al. 1994 and refs. therein).

Incidental catch: A few incidental catches of northern right whale dolphins occur in purse-seine operations in Japan and the Soviet Union, and small numbers have been killed in commercial and experimental salmon drift-net operations in the western and central Pacific (Jefferson et al. 1994 and refs. therein).

L. borealis has experienced very high levels of fishery-induced mortality in international high-seas, large-scale driftnet fisheries, from about 38°N to 46°N, and 171°E to 151°W. Assessing the impact of these mortalities is difficult, however, because of the possible existence of a coastal population off California and the Pacific Northwest that is separate from offshore populations (Dizon et al. 1994). Total numbers killed by the North Pacific squid driftnet fleets of Japan, Taiwan, and South Korea in the late 1980s were estimated at about 15,000-24,000 per year, and this mortality is considered to have depleted the population to 24-73 % of its pre-exploitation size (Mangel, 1993).

Northern right whale dolphins have also been observed entangled in net debris in the western Pacific. The total reported take of northern right whale dolphins by Japan in 1987 was 261 individuals, but this is likely an underestimate of the true numbers taken. Although there have been no directed fisheries for northern right whale dolphins in the eastern Pacific, they have been killed incidentally in other activities. There are reports of beachstranded specimens that had been shot. Small numbers have been reported taken in American drift nets set for sharks and swordfish off southern California, Oregon and Washington. A short-lived Canadian experimental driftnet fishery for flying squid killed a total of 13 in 1986 and 1987 (Jefferson et al. 1994 and refs. therein).

Pollution: The effects of habitat degradation and pollution on right whale dolphins are unknown, but their pelagic habitat is probably safer from human effects than coastal areas are. The seasonal shoreward movements of right whale dolphins may put them at increased risk during certain times of the year (Jefferson et al. 1994).

7. Remarks

Acording to Mangel (1993), the United Nations (U.N.) resolutions concerning high-seas driftnets called for moratoria by July 1992, unless appropriate conservation measures could be enacted. The analyses presented by Mangel (1993) show that the population of northern right whale dolphin has been affected by driftnets and that no apparent conservation measures are available:

The enormous variability associated with the estimates of population size create difficulties for "statistically sound analysis" of management plans, as called for by the U.N. resolutions. In addition, depletion caused by high-seas driftnet fisheries could even be greater than the worst-case estimate reported at a scientific review in June 1991. Any "statistically sound analysis" must include discussion of statistical power. To date, this has not been done. The importance of statistical power is that it places the burden of proof upon the fishing nations that wish to claim either no effect or a successful management plan (Mangel, 1993).

The catches of driftnets are highly aggregated. Reporting a kill rate of a fraction of an animal per unit of effort assumes that driftnets "cull" the population of animals and masks the more important effect of large, simultaneous kills of large fractions of pods, families, or other reproductive units. In addition, aggregated catches may lead to underestimates of the necessary level of observer effort. However, the operational characteristics of high-seas driftnet fisheries make impossible any management or conservation plan in which highly aggregated catches do not occur (Mangel, 1993).

L. borealis is not listed by the IUCN or CMS. However, South-North as well as inshore-offshore movements have been reported from both sides of the Pacific, so *Lissodelphis borealis* seems to be a good candidate for inclusion into App. II of CMS. Range states include Mexico, the US, Canada, Russia, Japan and possibly North and South Korea.

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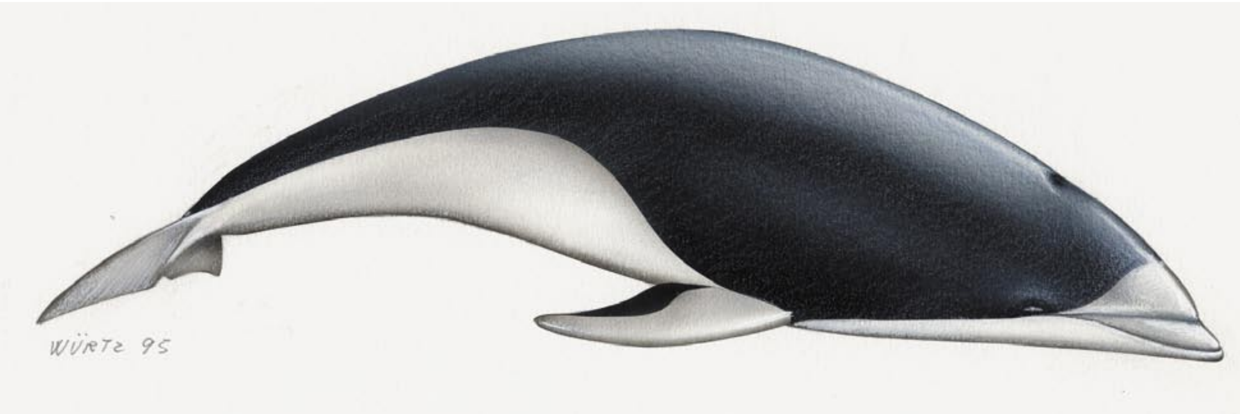
5.30 Lissodelphis peronii (Lacépède, 1804)

English: Southern right-whale dolphin
German: Südlicher Glattdelphin
Spanish: Delfín liso austral
French: Dauphin aptère austral



Drawing of Lissodelphis peronii © Wurtz-Artescienza.

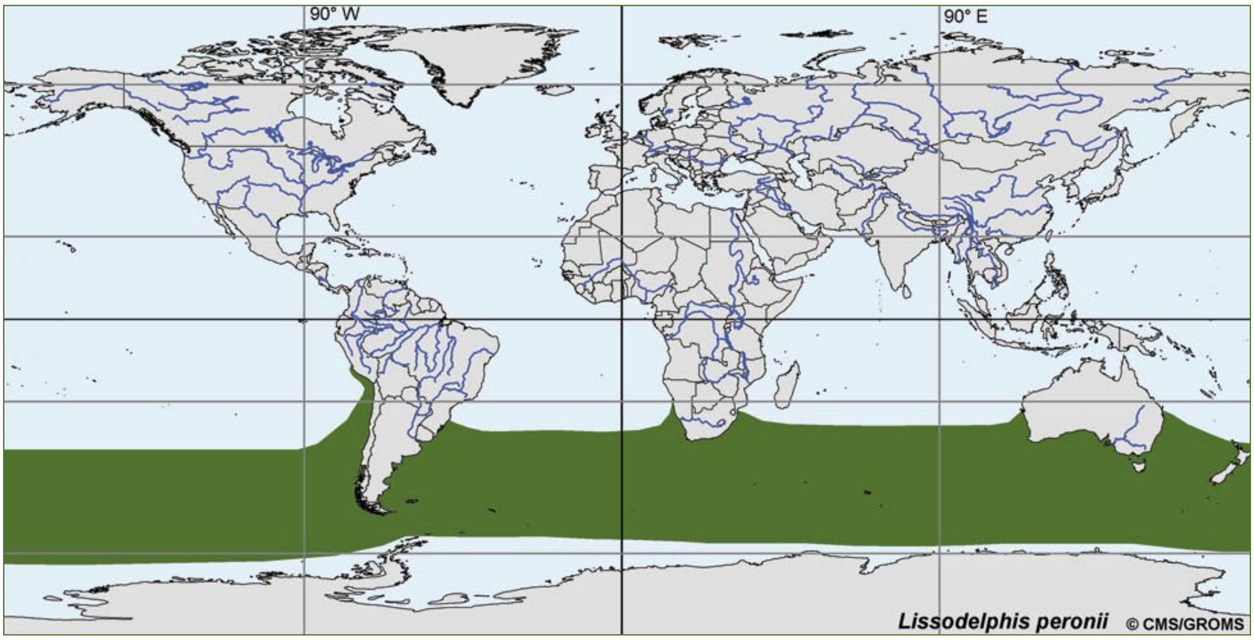
1. Description

Right whale dolphins are easy to identify at sea because of their distinctive black and white colour and lack of dorsal fin. The southern right whale dolphin has a white ventral patch, which extends higher on the posterior flanks than in *L. borealis* (see page 146). Its back is black, and the white area reaches a high point midway along the body, dipping down at the flipper insertion and covering most of the head and rostrum. Newborn calves are first brown or dark grey and attain adult coloration after the first year of life. Size reaches ca. 3 m, males growing larger than females, and body mass reaches up to 116 kg (Lipsky, 2002).

2. Distribution

The southern right-whale dolphin is circumpolar in the Subantarctic Zone, mainly between 40°S and 55°S. It ranges north to 25°S off São Paulo in Brazil, 23°S in the Benguela Current off Walvis Bay in Namibia, the Great Australian Bight, the Tasman Sea, the Chatham Islands, and 12°30'S in the Humboldt Current off Pucusana in Peru (Rice, 1998).

The distribution of this species is poorly known, though it appears to be circumpolar and fairly common throughout its range. *Lissodelphis peronii* remains almost exclusively in temperate waters, with most



Distribution of Lissodelphis peronii: deep, cold temperate waters of the southern hemisphere (mod. from Lipsky, 2002; © CMS/GROMS).

records from north of the Antarctic Convergence. It frequently follows the cold Humboldt Current into subtropical latitudes, as far north as 19°S off northern Chile, though the northernmost record is 12°S off Peru. The southernmost limit of the range varies with sea temperatures from year to year. The species seems to be fairly common in the Falklands Current between Patagonia and the Falkland Islands and is believed to occur across the southern Indian Ocean following the West-wind Drift. *L. peronii* is seldom seen near land except in sufficiently deep water; however, it is known to occur in coastal waters off Chile and near New Zealand where water is deeper than 200-m (Jefferson et al. 1994; Carwardine, 1995; Jefferson et al. 1993).

3. Population size

Preliminary boat surveys and the rapid accumulation of stranding and fishery interaction records in northern Chile suggest that the southern right whale dolphin may be one of the most common cetaceans in this region (Jefferson et al. 1994 and refs. therein; Van Waerebeek et al. 1991). Aguayo et al. (1998) report that *L. peronii* are very common between Valparaiso and 76°W, i.e. just off the Chilean coast.

4. Biology and Behaviour

Behaviour: *L. peronii* often travels very fast in a series of long, low leaps: the overall impression is of a bouncing motion rather like a fast-swimming penguin. It sometimes swims slowly, causing little disturbance of the water and exposing only a small part of its head and dark back when surfacing to breathe. Breaching (but with no twisting or turning in the air), belly-flopping, side-slapping, and lobtailing have been observed. Dives may last 6 minutes or more. Some schools will allow close approach, but others flee from boats. Small groups will bow-ride on rare occasions (Carwardine, 1995).

Habitat: Southern right whale dolphins are observed most often in cool, deep, offshore waters with temperatures of 1-20°C. They are sometimes seen nearshore, especially where deep water approaches the coast (Jefferson et al. 1994 and refs. therein).

Schooling: Large schools are characteristic. Some estimates of group size range to over 1,000 animals. Associations with other marine mammal species are common, especially dusky dolphins and pilot whales (Jefferson et al. 1993). Mean herd size is 210 individuals for southern right whale dolphins off Chile (Van Waerebeek et al. 1991).

Food: A variety of fish and squid have been reported as prey; lanternfish are especially common (Jefferson et al. 1993).

5. Migration

There is some suggestion of inshore and northward summer movements by southern right whale dolphins from sighting records off South Africa; however other authors suggested that southern right whale dolphins may be year-round residents off Namibia, southern Africa (Rose and Payne, 1991). Although the sample size is still small, north of 25°S off western South America more fresh specimens and sighting records have been registered in July-September than in all other months combined, suggesting a northern migration in the austral winter and spring (Jefferson et al. 1994 and refs. therein; van Waerebeek et al. 1991).

6. Threats

Direct catch: Southern right whale dolphins are reportedly infrequently caught off the coasts of Peru and Chile, where they are used for human consumption or crab bait (Jefferson et al. 1994 and refs. therein).

Incidental catch: They are known to be taken incidentally in driftnets along the coasts of Peru and Chile (Jefferson et al. 1993). Peddemors (1999) reports that *L. peronii* appears to be extremely localised in distribution within southern Africa, and any future planned expansion of commercial driftnet fisheries off Namibia should be carefully monitored for incidental catches which may impact this population.

7. Remarks

This is a poorly known species which seems to be threatened mainly by driftnet fisheries in Chilean and South African waters. Because no population estimates are available, mortality rates and their effect on the population are unknown. More research is clearly needed. For South American stocks, see further recommendations in Hucke-Gaete (2000) in Appendix 1.

L. peronii is listed as "Data Defficient" by the IUCN. It is not listed by CMS.

Migrations along the coast of South America suggest that national boundaries might be crossed. Therefore, inclusion into CMS Appendix II is recommended. Range states in South America are Peru, Chile, Argentina, Uruguay and Brazil, as well as the UK (Falkland / Malvinas Islands).

Further potential range states include South Africa, Namibia, Madagascar, Australia, New Zealand and France (Iles Kerguélen).

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Genus Mesoplodon – Beaked Whales: Introduction and Sources

The distribution of many *Mesoplodon* species is known almost entirely from records of stranded individuals. This situation is due to the difficulty in making specific identifications of these animals at sea and the relative rarity of sighting them at all (Mead, 1989). However, the distributional conclusions that are drawn from stranded animals are tentative due to the likelihood that these animals were diseased and strayed from their normal range. It is only when there is a large sample of strandings that have come from the same area that relatively firm distributional conclusions can be drawn. Care must also be taken in the weight which one gives to negative distributional data. In some cases there may be animals frequenting the waters and stranding upon the shores but there has not been enough cetological activity in the area to bring the strandings to the attention of scientists (Mead, 1989).

Unfortunately, correct identification of mesoplodont specimens also seems to be fraught with difficulties. Dalebout et al. (1998) report that to assist in the species-level identification of stranded and hunted beaked whales, they compiled a database of 'reference' sequences from the mitochondrial DNA control region, for 15 of the 20 described ziphiid species. Reference samples for eight species were obtained from stranded animals in New Zealand and South Australia. Sequences for a further seven species were obtained from a previously published report. This database was used to identify 20 'test' samples obtained from incompletely documented strandings around New Zealand. Analyses showed that four of these ' test' specimens (20 % !) had initially been misidentified. These included two animals of particular interest: a Blainville's beaked whale (*Mesoplodon densirostris*), the first record of this species in New Zealand waters, and a juvenile Andrews' beaked whale (*Mesoplodon bowdoini*).

Populations size

According to Pitman (2002) so few mesoplodonts have been reliably identified at sea that it is impossible to accurately determine the population status of any species, although, based on stranding data, at least some species may not be as rare as the sightings records indicate. *M. grayi*, *M. layardii* and *M. densirostris* seem to be widespread and fairly common, whereas e.g. *M. bowdoini* and *M. hectori* are rather rare.

The best available abundance estimate of beaked whales for the western North Atlantic stock is 3,196, whereas the estimate for the northern USA Atlantic is 2,600 and for the southern USA Atlantic 596 (data from 1998, in Waring et al. 2001).

Habitat

According to Pitman (2002) mesoplodont whales normally inhabit deep ocean waters (>2000 m deep) or continental slopes (200-200 m) and only rarely stray over the continental shelf. Whereas *M. densirostris* is found in all tropical and warm temperate oceans, most species are restricted to one or two broad ocean areas. The distribution of *M. perrini* could be considered localized (MacLeod, pers. comm.).

Migration

M. layardii may undergo some limited migration to lower latitudes during local winter (Pitman, 2002) and *M. bidens* may undergo migration in the eastern Atlantic (MacLeod et al. unpublished).

Food

Mead (1989) reports that all beaked whales feed primarily on deep-water mesopelagic squid, although some fish may also be taken (Pitman, 2002; MacLeod et al. 2003). Most prey are probably caught at depths exceeding 200 m via suction, as the dentition is much reduced and the mouth and tongue are highly adapted for this feeding method (Pitman, 2002). Diving durations of 20–45 min have been reported, after which groups of animals surface together and stay within 1 body length of each other (Pitman, 2002).

MacLeod et al. (2003) review published data on dietary preferences of beaked whales (Ziphiidae) from stomach contents analysis. Detailed data were only available for three of the six beaked whale genera (*Hyperoodon*, *Mesoplodon* and *Ziphius*). Stomach samples of these three beaked whale genera primarily contained cephalopod and fish remains, although some also contained crustaceans. *Mesoplodon* spp. were found to contain the most fish, with some species containing nothing but fish remains, while the southern bottlenose whale (*Hyperoodon planifrons*) and Cuvier's beaked whale (*Ziphius cavirostris*) rarely, if ever, contained fish. Of cephalopods identified, Histiotheutid, Gonatid, Cranchiid and Onychoteuthid species usually contributed most to prey numbers and biomass. There was a wide range of species and families of cephalopods recorded from stomach contents, with no obvious preference for bioluminescent prey species, vertical migrating prey species or prey species with specific body conditions. Whales of the genus *Mesoplodon* generally contained smaller prey, such as cephalopods under 500 g in weight, compared with other beaked whales. *Hyperoodon* and *Ziphius* frequently contained much larger cephalopods with many important species having a mean weight of over 1000 g. This suggests that *Mesoplodon* occupies a separate dietary niche from *Hyperoodon* and *Ziphius*, which may be an example of niche separation. In contrast, *Hyperoodon* and *Ziphius* appear to occupy very similar dietary niches but have geographically segregated distributions, with *Hyperoodon* occupying cold-temperate to polar waters and *Ziphius* occupying warm-temperate to tropical waters.

Threats

Although there has never been a directed fishery, some animals are occasionally taken by opportunistic whalers, or die in drift nets and lost fishing gear (Pitman, 2002). Off the north-east US coast, 46 fishery-related mortalities were observed in the pelagic drift gillnet fishery between 1989 and 1998: 24 Sowerby's, 4 True's and 17 unidentified beaked whales (Waring et al. 2001).

Species accounts

see below.

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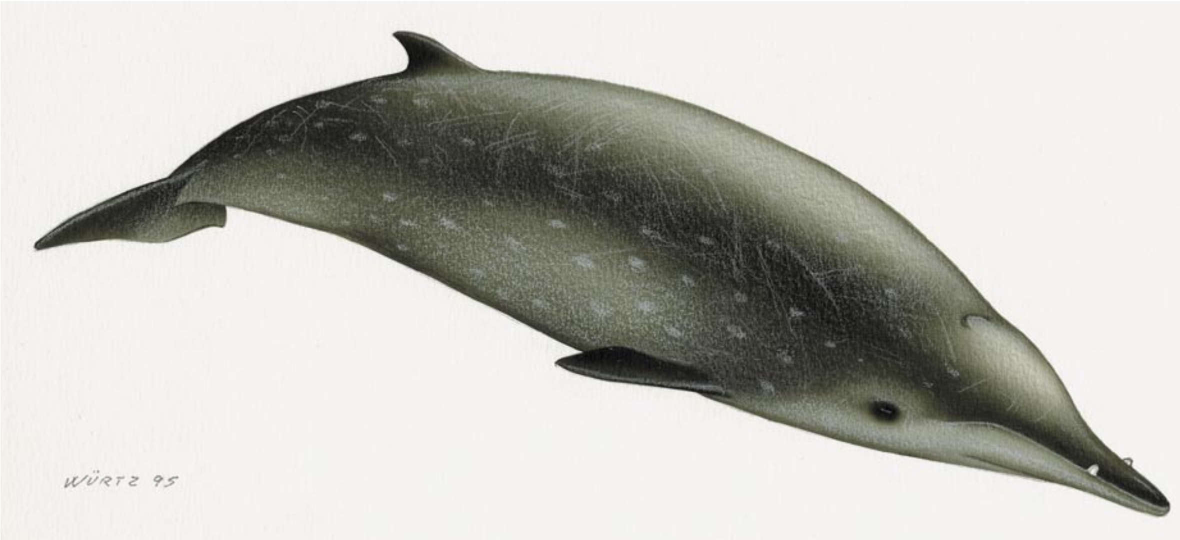
5.31 Mesoplodon bidens (Sowerby, 1804)

English: Sowerby's beaked whale, North Atlantic beaked whale
German: Sowerby-Zweizahnwal
Spanish: Zifio de Sowerby
French: Mésoplodon de Sowerby



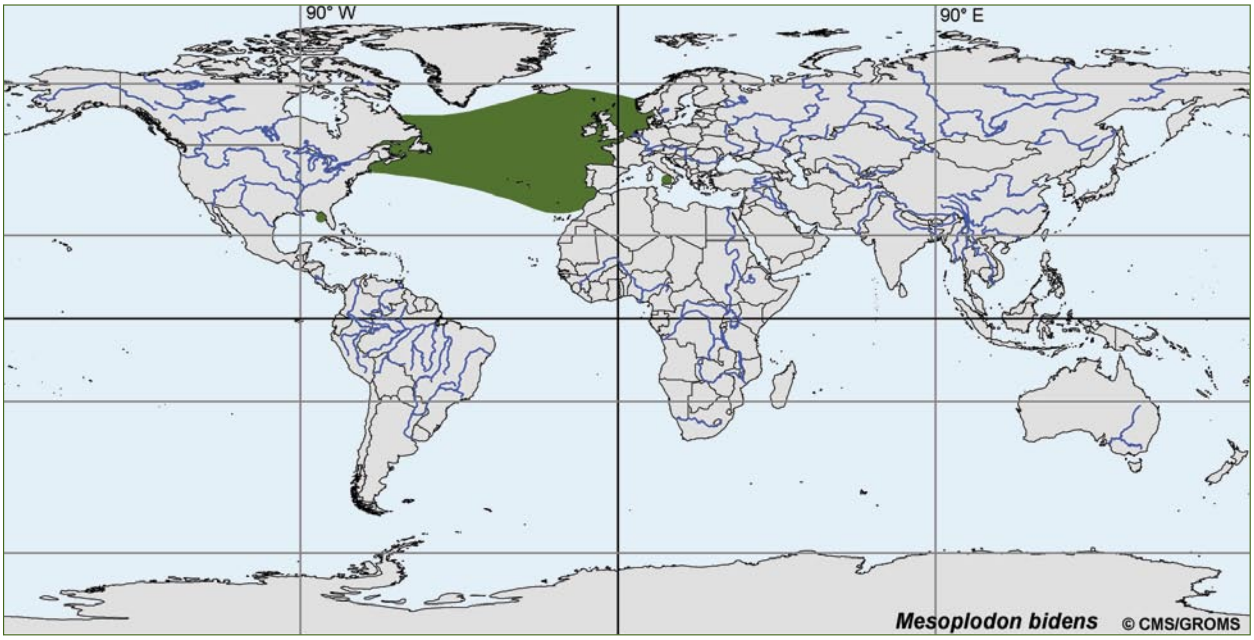
Drawing of Mesoplodon bidens © Wurtz-Artescienza.

1. Description

Adults are bluish grey or slate coloured, with grey to white flanks and belly. Young are generally paler and have fewer scars than the adults. Two teeth are found in the middle of the lower jaw; these protrude outside the mouth in males but not in females or young. The largest male recorded was 5.5 m long, the largest female 5.2 m (Ward, 2000; MacLeod, unpublished).

2. Distribution

Sowerby's beaked whale occurs in the temperate North Atlantic from the Labrador Sea (54°N; Mac Leod unpublished), Wild Bight (49°48'N, 55°56 'W) in Newfoundland, 71°30'N, 04°00'E in the Norwegian Sea, and Smola (63°25'N) on the west coast of Norway, south to Nantucket Island in Massachusetts, the Azores, and Madeira. This species is unlikely to live in



Distribution of Mesoplodon bidens (mod. from Carwardine, 1995; © CMS/GROMS). The species is found in the temperate and subarctic waters in the eastern and western North Atlantic (Pitman, 2002).

the Baltic, where the water is too shallow (Carwardine, 1995). Stray specimens have been recorded from Florida (Mac Leod, pers. comm.)

According to Mac Leod (pers. comm.) Sowerby's beaked whale is known mainly from 150 strandings. This may seem a small number, but among the genus *Mesoplodon* it is exceptionally high. Most records stem from the eastern North Atlantic, especially around Britain. Recently, Kinze et al. (1998) reported a stranding from the Danish North Sea coast and Smeenk (1995) found a stranded specimen on the Dutch coast. There is one stranding report from Italy (Carwardine, 1995).

According to Lien and Barry (1990) specimens have been encountered only 11 times in the western North Atlantic through two mass strandings, seven strandings of individuals and in two sightings. In the western North Atlantic, stranding reports stem mainly from Newfoundland, Canada, and Massachusetts, US, but also from northern Labrador, Canada, and a single record from Florida, USA (Carwardine, 1995). Recently, Lucas and Hooker (2000) reported a stranding from Nova Scotia. Although there are more recorded strandings of this whale on British and European coasts, its range appears to be generally offshore throughout the North Atlantic.

Carlstroem et al. (1997) report that two Sowerby's beaked whales were observed in sea state 0–1 on 16 July 1995 at 71° 30'N 04°00'E in the Norwegian Sea. A number of morphological features, such as dentition, were clearly seen during the encounter. According to these authors, the Sowerby's beaked whale's core distribution is in the North Sea, although Mac Leod (pers. comm.) does not agree as there are many more sightings south of this area and in the western Atlantic.

The sighting in the Norwegian Sea suggests that the current data on the species distribution is uncertain, and that its range may include the polar waters of the Norwegian Sea (not shown on map). This is confirmed by Mac Leod (2000) who found that *M. bidens* is the most northerly recorded Mesoplodont species in the North Atlantic followed by *M. mirus*: The distribution of *Mesoplodon* species may relate to variations in water temperature.

3. Population size

no entries.

4. Biology and Behaviour

Habitat: Although it is one of the most commonly stranded *Mesoplodon* species, there have been few sightings at sea, and it is poorly known. De Buffrénil (1995b and references therein) mentions that two sightings were north of Scotland and west of the Orkney Islands, in waters several 100 m deep. Hooker and Baird (1999) observed groups of Sowerby's Beaked Whales in the Gully, a submarine canyon off eastern Canada, on four occasions. Sightings were in water depths of between 550 and 1500 m. *Mesoplodon bidens* has one of the most northerly distributions of all the beaked whales, which should help with identification. However, parts of its range overlap with other *Mesoplodon* species, especially Gervais' Beaked Whale, Blainville's Beaked Whale, and True's Beaked Whale, and it is likely to be difficult to distinguish it from these with any certainty at sea (Carwardine, 1995).

Behaviour: Hooker and Baird (1999) observed Sowerby's Beaked Whales to dive for between 12 and 28 minutes. Blows were either invisible or relatively inconspicuous. During all surfacings the long beak projected from the water well before the rest of the head or back was visible. While surfacing behaviour was generally unremarkable, one individual tail-slapped repeatedly.

Schooling: According to De Buffrénil (1995b and references therein) stranded animals usually occur singly. In those cases where two animals stranded together, these were mother-calf pairs.

Hooker and Baird (1999) found that group size in the Gully varied from 3 to 10 individuals. A mixed-composition group was observed on one occasion, consisting of at least two female-calf pairs and two to four adult males (based on the presence of visible teeth and extensive scarring). Another group consisted of three quite heavily-scarred and therefore presumably male animals.

The formation of larger groups is also supported by Lien et al. (1990) who report on two strandings of *Mesoplodon bidens* which occurred in Newfoundland; one in 1986 with six individuals and a second stranding in 1987 which involved three whales.

Food: Freshly killed *Mesoplodon bidens* primarily contained bottom-dwelling deep-water (greater than 400 m) fish of between 100 and 200 mm (Gannon et al. 1998). Ostrom et al. (1993) evaluated the diet of Sowerby's beaked whales based on isotopic comparisons among northwestern Atlantic cetaceans and found that the species feeds mostly on small, offshore squid. See also MacLeod (in press) for further details.

5. Migration

Little is known about migration; most northerly animals may migrate with advancing and retreating ice, and some populations may move towards the coasts during summer. Year-round strandings are recorded, especially from July to September. Animals probably live some distance offshore (Carwardine, 1995; de Buffrénil, 1995b and references therein).

According to Mead (1989) there does not seem to be any seasonality in the European stranding records. The only country for which enough records exist to make a seasonal analysis valid is the United Kingdom (41 records). Strandings have been reported in every month except February, with a tendency towards a broad peak in the summer (July-September). According to MacLeod et al. (pers. comm.) most strandings of Sowerby's beaked whales occurred in late summer and autumn on eastern coasts of the UK which may coincide with a southward movement.

6. Threats

Occasionally, individuals were caught incidentally in fishing gear (De Buffrénil, 1995b), e.g. in Newfoundland small-scale fishery (Jefferson et al. 1993).

Waring et al. (2001) report that for 1989-1998 observed by-catch rates in pelagic drift gillnets along the US East Coast amount to 24 Sowerby's beaked whales. These were caught exclusively in the area from Georges Canyon to Hydrographers Canyon along the continental shelf break and continental slope during July–October. Catches of other beaked whale species were significantly lower.

7. Remarks

The species is poorly known. However, its distribution spans most of the North Atlantic and strandings do occur on the west and east coasts of the Atlantic ocean. Range states should be encouraged to conduct more coordinated research efforts.

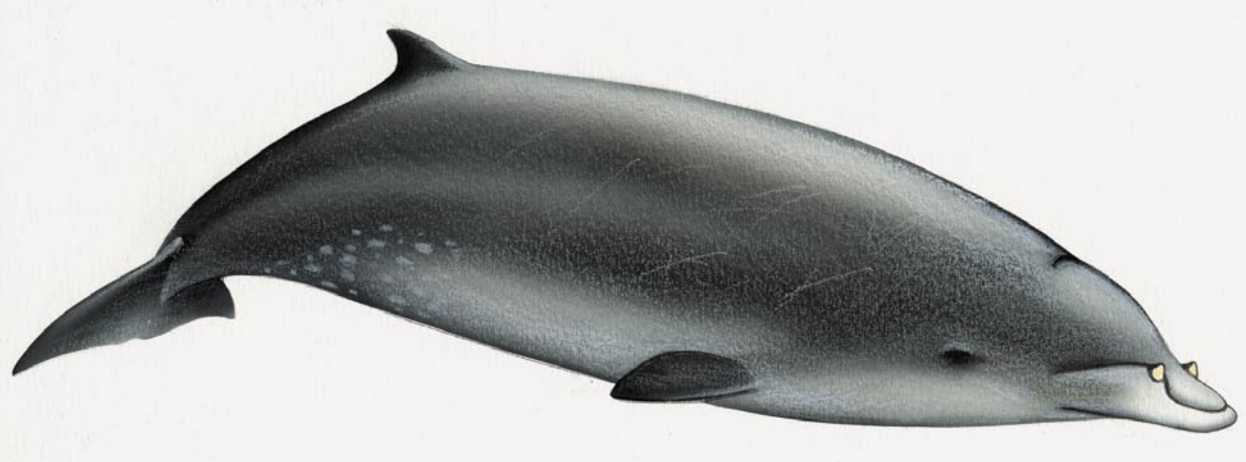
The species is categorised as "Data Deficient" by the IUCN and is not listed by CMS.

8. Sources

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources" (page 154.)

5.32 Mesoplodon bowdoini (Andrews, 1908)

English: Andrews' beaked whale
German: Andrews'-Zweizahnwal
Spanish: Zifio de Andrew
French: Mésoplodon de Andrew

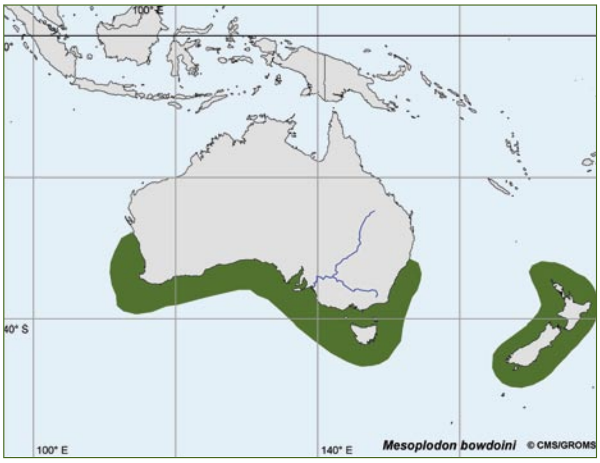


Drawing of Mesoplodon bowdoini
© Wurtz-Artescienza.

1. Description

Adult males are black to dark blue all over, except for the tip of the rostrum and the lower jaw, which are white. The two teeth located in the lower jaw are set in raised sockets at the middle of the beak; these erupt in males but not in females. The longest female recorded measured 4.6 m. Resembles very much Hubb's or Stejneger's Beaked Whales at sea (Ward, 2001).

Mesoplodon bowdoini can be distinguished from all other species of *Mesoplodon* by the shape of its teeth (male and female), and differences in the morphology of its skull, especially the proportions of the rostrum, separation of the nasals, the shape of the prominential notches, and the nature of the antorbital processes. The species' distinguishing external characteristics are: a robust body up to about 4.50 m long; a low melon and short, thick beak; an elevated jawline posteriorly; and a low, blunt-tipped, triangular dorsal fin (Baker, 2001).



Distribution of Mesoplodon bowdoini (mod. From Carwardine, 1995; © CMS/GROMS). The species seems to prefer the cool temperate waters off New Zealand and southern Australia where it is known from strandings (Pitman, 2002).

2. Distribution

Andrews' beaked whale is found in the Southern Indo-Pacific; it is known only from Western Australia, Victoria, Tasmania, New South Wales, and North, South, Stewart, and Campbell islands in New Zealand (Rice, 1998). However, the current picture of distribution may also be due to more efficient location and recording of stranded animals in New Zealand and Australia than elsewhere (Carwardine, 1995). According to Baker (2002) *Mesoplodon bowdoini* is known only from 35 specimens and has a southern, circumpolar distribution north of the Antarctic convergence, between 32°S and 54 degree 30'S.

3. Biology and Behavior

Almost nothing is known about the behavior of *Mesoplodon bowdoini*. Lack of sightings in the wild suggests that Andrew's beaked whales are unobtrusive or live away from well-studied areas. Their close relationship with Hubbs' Beaked Whale suggests the two species may have similar behavior patterns. Body scarring indicates fighting between males. They are probably extremely difficult to identify at sea, and even stranded animals have been misidentified in the past (Carwardine, 1995).

The occurrence of fetuses of *M. bowdoini* in May and September, and perinatal juveniles in May and June, indicates a summer-autumn breeding season in the New Zealand region; the length at birth is estimated at about 2.20 m.

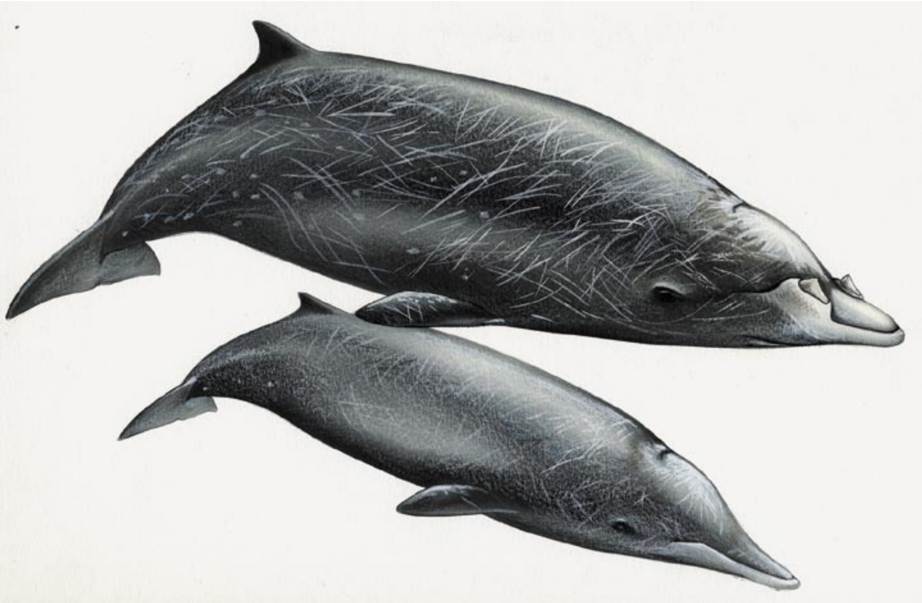
The species is categorised as "Data Deficient" by the IUCN. *Mesoplodon bowdoini* is not listed by CMS.

4. Sources and further Information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources" (page 154).

5.33 Mesoplodon carlhubbsi (Moore, 1963)

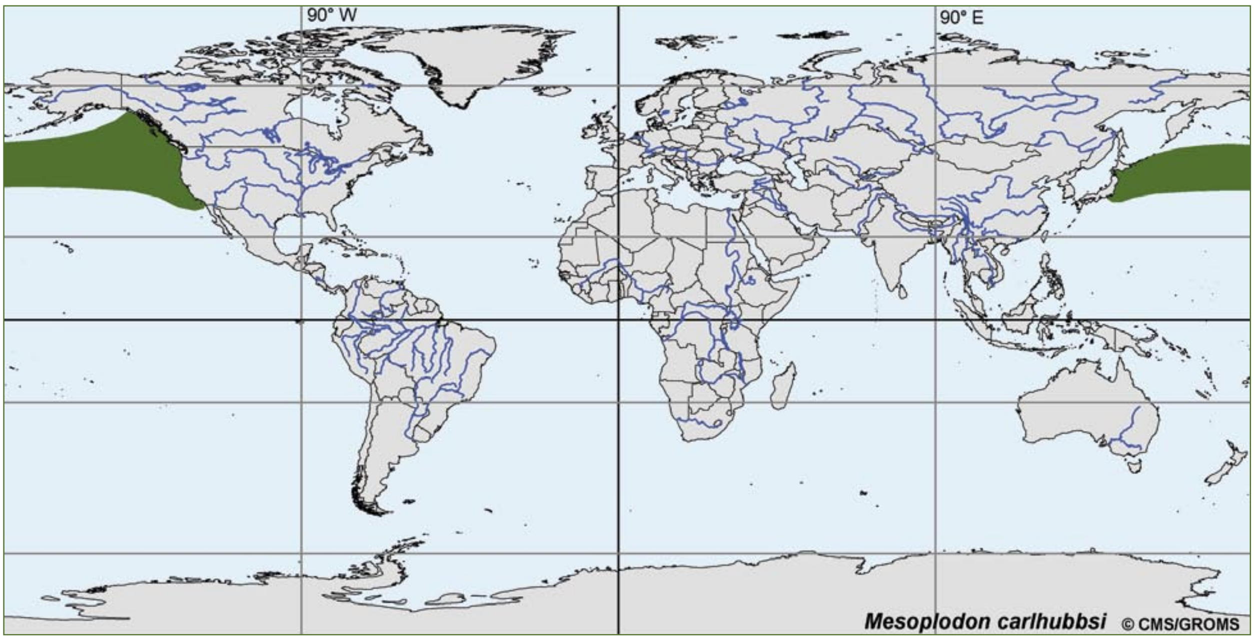
English: Hubbs' beaked whale
German: Hubbs-Zweizahnwal
Spanish: Zifio de Hubbs
French: Mésoplodon de Hubbs



Drawing of Mesoplodon carlhubbsi © Wurtz-Artescienza.

1. Description

Adult females and the young are medium grey which fades through lighter grey to white on the flanks and undersides. Males are dark grey to black, save for a white region from the rostrum's tip and lower jaw to the back of the teeth, and another around the blow hole. Two prominent teeth erupt from the rear of their lower jaw, but remain concealed in females. The skin may have many scratches from other males' teeth. Both the longest male and the longest female specimens measured 5.3 m (Ward, 2001).



Distribution of Mesoplodon carlhubbsi (mod. from Carwardine, 1995 and Pitman, 2002; © CMS/GROMS). Hubbs' beaked whale is found in the temperate North Pacific from California to Japan (Pitman, 2002).

2. Distribution

Hubbs' beaked whale is found in temperate waters of the North Pacific. In the west it has been recorded from the northeastern coast of Honshu; in the east it is found from Prince Rupert in British Columbia south to San Diego in California (Rice, 1998). According to Houston (1990b) it is known from only 31 stranded specimens and one possible live sighting. Most strandings have been along the North American coast from Prince Rupert, British Columbia to La Jolla, California. Four strandings are recorded from Ayukawa, Japan.

3. Population size

no entries.

4. Biology and Behaviour

The male Hubbs' Beaked Whale is one of the few beaked whales that could be positively identified at sea, although there has been only a single probable sighting (near La Jolla, California, USA). Females and juveniles are probably impossible to identify at sea; they have medium gray upper sides, lighter gray sides, and white undersides and their teeth do not erupt. With only a single possible sighting, very little is known about their behavior. The remarkable degree of scarring suggests considerable aggression between males. Presumably, Hubbs' Beaked Whales are shy and unobtrusive like other *Mesoplodon* species (Carwardine, 1995).

5. Migration

no entries.

6. Threats

The species is not known to have been, or to be, of interest to commercial fisheries and is probably protected by its rarity and occurrence in less frequented (by man) waters of the North Pacific (Houston, 1990b). As opposed to this, Jefferson et al. (1993) report that some Hubb's beaked whales have been taken by harpoon off Japan.

7. Remarks

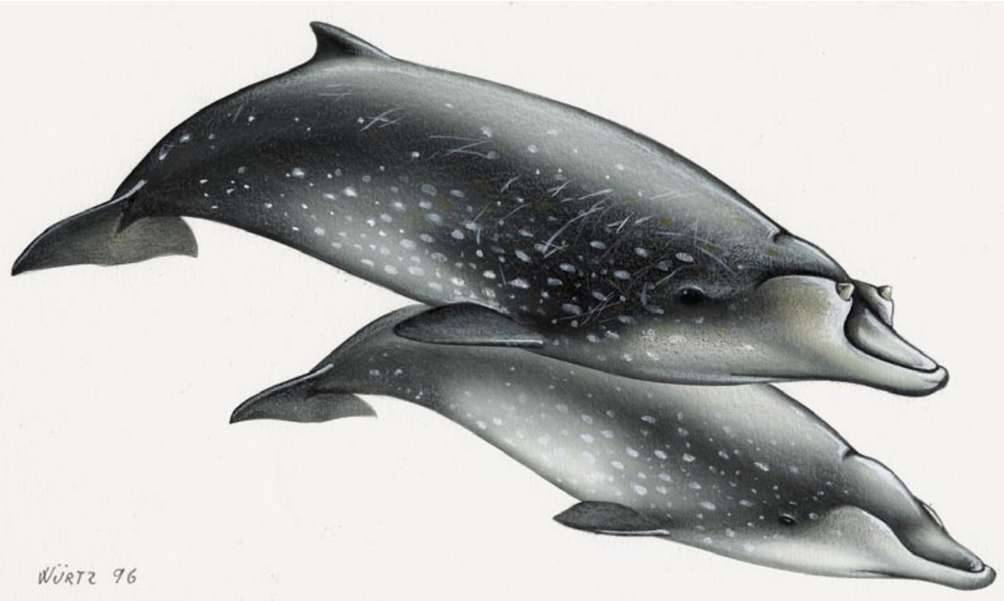
Hubbs' Beaked Whale is categorised as "Data Deficient" by the IUCN and is not listed by CMS.

8. Sources

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.34 Mesoplodon densirostris (Blainville, 1817)

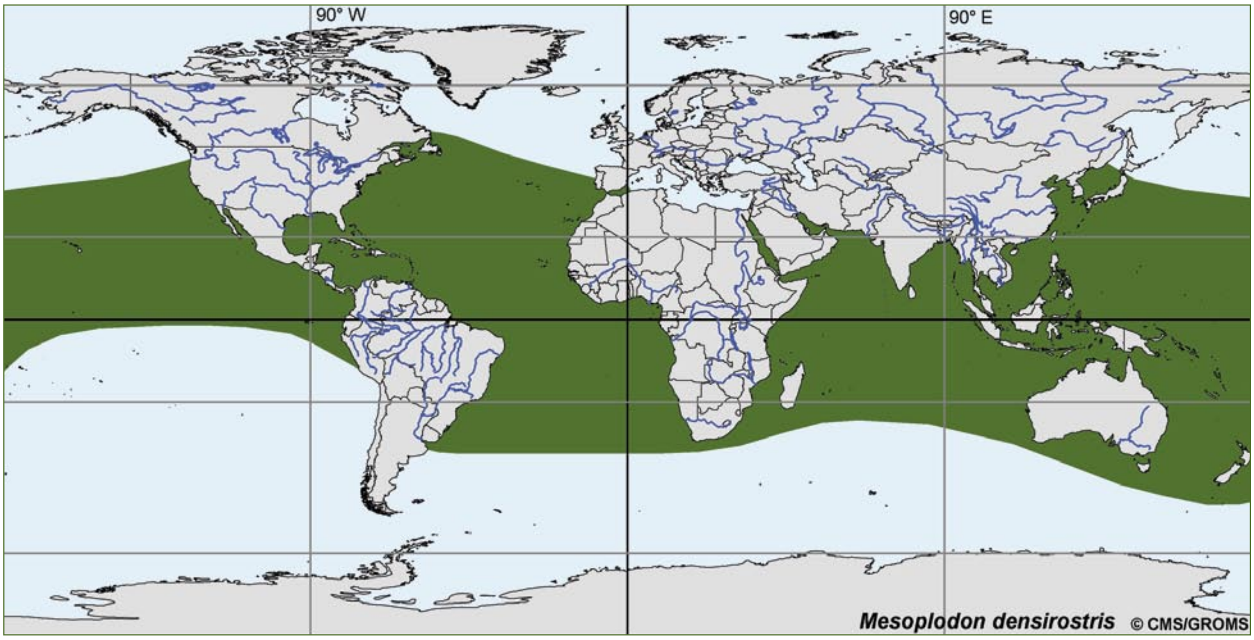
English: Blainville's beaked whale
German: Blainville-Zweizahnwal
Spanish: Zifio de Blainville
French: Mésoplodon de Blainville



Drawing of Mesoplodon densirostris © Wurtz-Artescienza.

1. Description

The main pattern of this species is dark above, light below, with a tendency for the dorsal fin to darken considerably in adults. In the young the belly is cream which darkens to a blue-grey hide. There is an eye patch which is also dark, with females alone developing both white upper and lower jaws and scars. The lower jaw is arched in the same fashion as the Right Whales', with a prominent tooth erupting at the peak of this arch in males. The maximum recorded lengths have been 4.7 m in both males and females (Ward, 2001). The male Blainville's Beaked Whale is one of the oddest-looking of all cetaceans. It has a pair of massive teeth that grow from substantial bulges in its lower jaw, like a couple of horns; these may be so encrusted



Distribution of Mesoplodon densirostris (mod. from Carwardine, 1995 and Pitman, 2002; © CMS/GROMS). This species is circumglobal in warm temperate and tropical waters (Pitman, 2002).

with barnacles that the animal appears to have 2 dark-coloured pompons on top of its head. This feature makes it relatively easy to identify at sea, although it is generally inconspicuous and difficult to find; it is known mainly from strandings. The flattened forehead and large spots all over its body, possibly made by the teeth of Cookie-cutter Sharks and parasites, are also characteristic.

Dalebout et al. (1998) report that they compiled a database of 'reference' sequences from the mitochondrial DNA control region, for 15 of the 20 described ziphiid species. This database was used to identify 20 'test' samples obtained from incompletely documented strandings around New Zealand. Analyses showed that four of these 'test' specimens (20%) had initially been misidentified. These included a Blainville's beaked whale, the first record of this species in New Zealand waters.

2. Distribution

Blainville's beaked whale prefers tropical and warm temperate waters around the world. It ranges north to Nova Scotia, Wales, Portugal, the western Mediterranean, Japan, Midway Islands, and central California; and south to Rio Grande do Sul in Brazil, South Africa, Tasmania, and central Chile (Rice, 1998). A recent report (Baker and van Helden, 1999) also indicates the presence of this species in New Zealand waters. McAlpine and Rae (1999) report on a stranding in New Brunswick, Canada. Aguayo et al. (1998) report on sightings between Valparaiso and Easter Island in the south-eastern Pacific Ocean.

According to Houston (1990c) Blainville's Beaked Whale is widely, if thinly, distributed in tropical and subtropical waters and occurs irregularly off the east coast of Canada. It has yet to be reported from the west coast, although one stranding has been reported from northern California. In the tropical oceans, *M. densirostris* is one of the more widespread and common beaked whales (Pitman, 2002).

3. Population size

no entries.

4. Biology and Behaviour

Habitat: Acording to Casinos and Filella (1995 and references therin), very little is known about behaviour or preferred habitat. *Mesoplodon densirostris* seems to avoid coasts, and observations around Hawaii seem to indicate that animals prefer water depths of 700– 1000 m. Ritter and Brederlau (1999) sighted *Mesoplodon densirostris* 24 times between September 1995 and August 1997 off La Gomera, Canary Islands. Of the seven sightings for which such information was recorded, mean depth was 320 m (SD = 270 m), and mean distance from shore was 4.4 km. According to Houston (1990c), the species appears to be more pelagic than other ziphiids. A more recent analysis by MacLeod (pers. comm.) however, comes to the conclusion that Blainville's beaked whales may actually occur in shallower water than other beaked whale species, and are the most commonly seen beaked whales in shallower waters around tropical oceanic islands.

Behaviour: *M. densirostris* performs a series of shallow dives at 15-to 20-second intervals, then dives for 20 to 45 minutes. On surfacing, the beak appears first, pointing skyward; after taking a breath, it is sometimes slapped against the surface of the water, and the animal may roll slightly before disappearing. It is believed to have unobtrusive habits (Carwardine, 1995). Ritter and Brederlau (1999) found that the reaction of the animals to the observation vessel varied from avoidance to approach. During two encounters swimmers were able to approach the whales underwater. For video footage see www.whaleresearch.org/main_beaked.htm

Schooling: Most strandings involved single individuals, although groups between 3 and 7 animals were observed in tropical waters (Jefferson et al. 1993). Ritter and Brederlau (1999) estimated group size to range from 2 to 9 individuals (mean 3.44). Adult males and calves were both observed during many encounters.

5. Migration

no entries.

6. Threats

Incidental catches: Jefferson et al. (1993) report that some specimens have been taken in the North Pacific by Taiwanese whalers, and accidentally by Japanese tuna fishermen in the Indian ocean.

Direct catches: According to Houston (1990c), the species is of no commercial interest. However, Dolar et al. (1994) investigated directed fisheries for marine mammals in central and southern Visayas, northern Mindanao and Palawan, Philippines from archived reports and visits to sites where such fisheries are conducted. Hunters at Pamilacan Island take some small whales including *Mesoplodon densirostris*. Dolphins and whales are taken by hand harpoons or, increasingly, by togglehead harpoon shafts shot from modified, rubber-powered spear guns. Around 800 cetaceans are taken annually by hunters at the seven sites, mostly during the inter-monsoon period of February-May. Dolphin meat is consumed or sold in local markets and some dolphin skulls are cleaned and sold as curios. Although the Department of Agriculture issued Fisheries Administrative Order No. 185 on 16 December 1992: 'banning the taking or catching, selling, purchasing, possessing, transporting and exporting of dolphins', the order did not stop dolphin and whale hunting but seems to have decreased the sale of dolphin meat openly in the market.

Pollution: Concerns regarding the impact of man-made debris in the marine environment are increasing. Pollution in the form of plastic debris has been recently recognised as a major threat to marine wildlife, in terms of ingestion and entanglement. On 27 February 1993, a 419 cm adult female Blainville's beaked whale was found washed ashore in an advanced state of decomposition at Mar Grosso Beach (32°07'S, 52°02'W), Sao Jose do Norte, southern Brazil (Secchi and Zarzur, 1999). Stomach analysis revealed the presence of a blueish bundle of plastic threads occupying a large part of the main stomach chamber (volume of 35 cm^3 in terms of displaced liquid). Both stomach and intestines were completely free of parasites as well as food remains and faeces, indicating that the whale had not fed for some time. Mistaken ingestion of debris due to its resemblance to preferred prey is usually not thought to occur in odontocete cetaceans because of their echolocation capabilities. The ingested plastic may have resulted in a false sensation of satiation for the animal, which could have reduced the whale's appetite and meal size. In turn, this would have compromised the energy consumption and health of the animal and subsequently (at least indirectly), lead to the death of the whale.

One individual stranded in the Mediterranean sea was investigated with respect to chlorinated hydrocarbons. Levels found were lower than in other cetacean species (Jefferson et al. 1993).

Naval exercises: At least one animal died in September 2002 during a naval exercise conducted around Gran Canaria, Spain (Vidal Martin, pers. comm.). Another two specimens live stranded during a naval exercise off The Bahamas in March 2000 (Waring et al. 2001). High intensity Low Frequency Active Sonar (LFAS) was used by US and NATO vessels in both these areas, respectively, which led to a multi species mass stranding also including *M. densirostris* and *Ziphius cavirostris* (see pages 165 and 325).

7. Remarks

The species is poorly known with respect to abundance, migratory patterns, by-catch and direct catch rates. It should be ensured that artisanal whale fisheries operate within sustainable limits and do not export products illegally. For recommendations on South American stocks, please see Hucke-Gaete (2002) in Appendix 1 and for south-east Asian stocks Perrin et al. (1996) in Appendix 2.

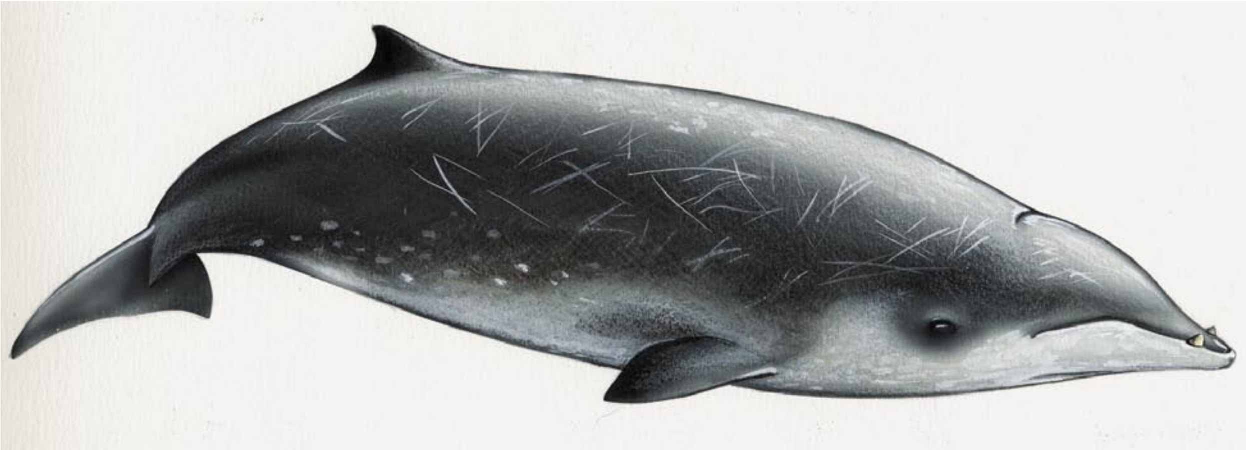
IUCN status: "Data Deficient". The species is not listed by CMS.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.35 Mesoplodon europaeus (Gervais, 1855)

English: Gervais' beaked whale
German: Gervais-Zweizahnwal
Spanish: Zifio de Gervais
French: Mésoplodon de Gervais



Drawing of Mesoplodon europaeus © Wurtz-Artescienza.

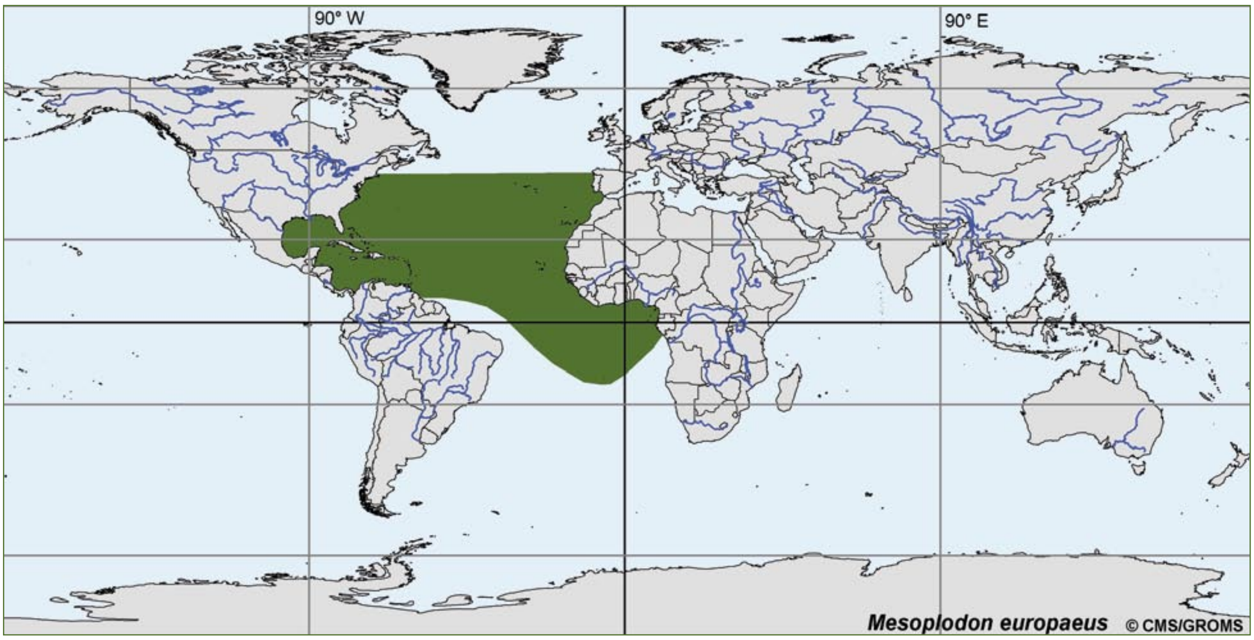
1. Description

Gervais' Beaked Whales are generally grey, which lightens to a pale grey on the undersides. The head is small and sometimes has a white tip. Two small front teeth are found towards the front of the mouth. The longest male measured 4.5 m, and the longest female 5.2 m, which suggests sexual dimorphism (Ward, 2001).

2. Distribution

Gervais' beaked whale occurs mainly in the North Atlantic including the Gulf of Mexico, from Texas and Florida to New York, Ireland, the English Channel, and Islas Canarias, south to Jamaica, Curaçao, Trinidad, Ascension Island, Mauritania, and Guinea Bissau (Rice, 1998).

While the distribution is inferred mainly from 54 strandings (Mead, 1989) these may not provide an adequate representation of the distribution at sea. Newest records seem to indicate a larger distribution in the temperate waters of the North Atlantic, not only (as shown on the map) near Florida and on the eastern coast of central America, but also in the Gulf



Distribution of Mesoplodon europaeus (mod. from Carwardine, 1995; © CMS/GROMS). The species prefers warm temperate and tropical waters in the North Atlantic (Pitman, 2002).

stream, the Canary Islands and in currents north of the equator. According to Robineau (1995) European seas seem to mark the end of the distributional area, but Martin et al. (2001) report of stranded specimens on the Canary Islands and Reiner et al. (1993) report of a specimen stranded on the Azores, which confirms the wider distributional range.

3. Population size

no entries.

4. Biology and Behaviour

The behavior of this species in the wild is a matter for conjecture. Lack of sightings in relatively well-studied areas within its range suggests that *Mesoplodon europaeus* is likely to be inconspicuous. It is probably a deep diver that lives in small groups or pairs. It has been known to become entangled in fishing nets (Carwardine, 1995).

Mead (1989) suggests that the species prefers deep waters, which is deduced from lack of sightings near shore. However, there are no observations at sea to test this hypothesis. Strandings suggest that the species prefers tropical and subtropical waters. There are no sightings in the wild (Robineau, 1995).

According to Jefferson (1993) Gervais' beaked whale seems to feed on squid.

5. Migration

no entries.

6. Threats

There is a record of one specimen having been taken in New Jersey and others may have been taken in Caribbean small cetacean fisheries (Jefferson, 1993).

From 1992 to 1998 a total of 49 beaked whales stranded along the US Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This included 28 Gervais' beaked whales, which was therefore the most frequently affected species (Waring et al. 2001). Furthermore, several unusual mass strandings of beaked whales, including also Gervais' beaked whales, were associated with naval activities: Mid to late 1980's on the Canary Islands (Waring et al. 2001), and again in September 2002 during a naval NATO maneuver involving low frequency sonar around the Canaries (Vidal, pers. comm.).

7. Remarks

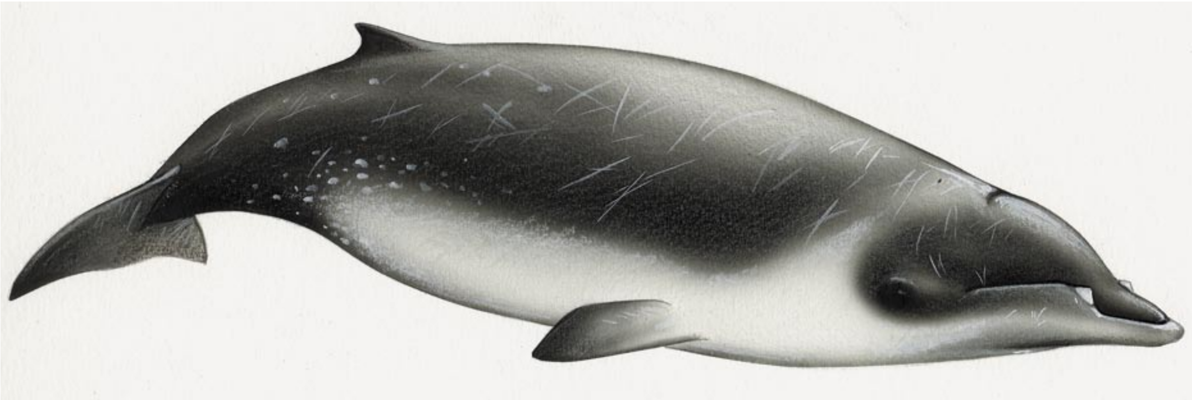
The species is categorised as "Data Deficient" by the IUCN. Gervais' beaked whale is not listed by CMS.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.36 Mesoplodon ginkgodens (Nishiwaki and Kamiya, 1958)

English: Ginkgo-toothed whale
German: Japanischer Schnabelwal
Spanish: Zifio de Nishiwaki
French: Mésoplodon de Nishiwaki



Drawing of Mesoplodon ginkgodens © Wurtz-Artescienza.

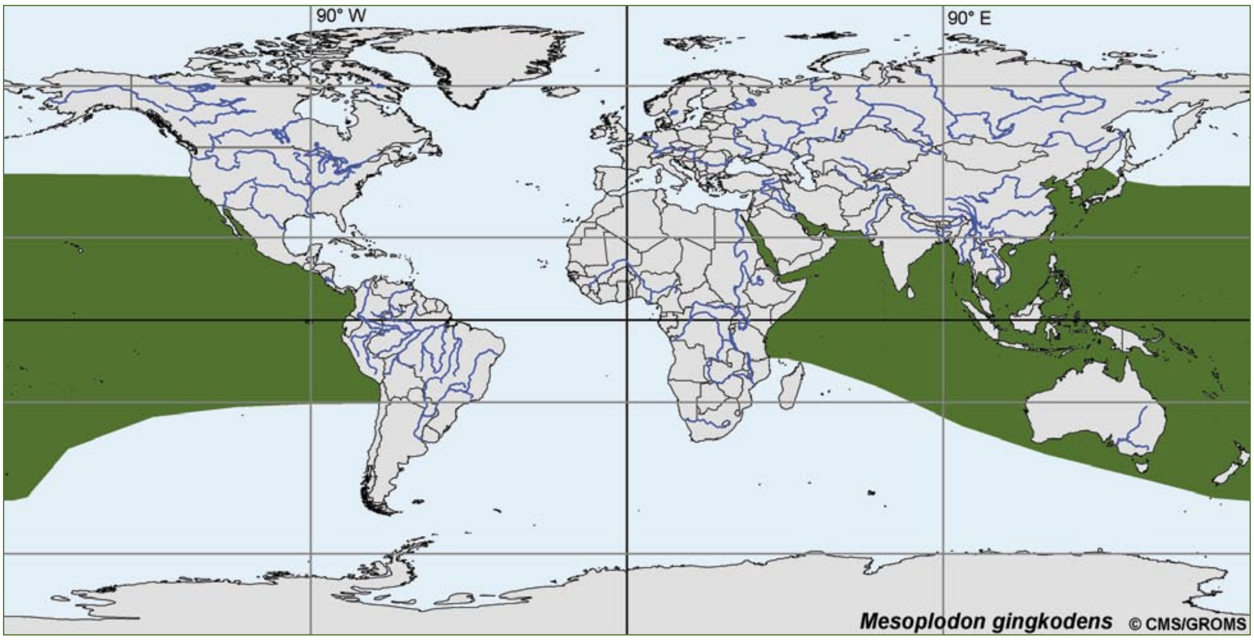
1. Description

Adult males are dark grey but females are lighter with pale undersides. The teeth on the lower jaw are found towards the middle of the beak and erupt only in mature males. The longest female measured 4.9 m, the longest male 4.7 m (Ward, 2001).

2. Distribution

Ginkgo-toothed whales are found in the tropical and warm temperate waters of the Indopacific; they have been recorded from Sri Lanka, the Strait of Malacca, Taiwan, Kyushu, the Pacific coast of Honshu, New South Wales, the Chatham Islands, southern California, the west coast of northern Baja California Sur, and the Galapagos Islands (Rice, 1998).

Palacios (1996) summarised that *Mesoplodon ginkgodens* is only known from 15 stranding records. Of these, eight are from the western North Pacific (Japan and Taiwan), three from the South Pacific (one from the Chatham Islands and two from Australia), and two from the Indian Ocean (Sri Lanka and Indonesia). The remaining two records are from the eastern North Pacific: a female stranded at Del Mar, California, US, in 1954 and a skull collected on 30 December 1980



Distribution of Mesoplodon gingkodens (mod. from Carwardine, 1995; © CMS/GROMS). The species occurs in tropical and warm temperate waters of the Indian and Pacific Oceans (Pitman, 2002).

at Playa Malarrimo, outside Laguna Ojo de Liebre (Scammon's Lagoon), Baja California, Mexico. Palacios (1996) documents an additional record of a specimen of *M. ginkgodens* from the Galapagos Islands, Ecuador, eastern tropical Pacific. Furthermore, Anderson et al. (1999) report on recent strandings on the Maldives in the Indian Ocean. Baker and van Helden (1999) showed that a tooth collected from the Chatham Islands that was considered to be *M. ginkgodens* was in fact *M. grayi*. In the same paper they described a specimen from White Island (New Zealand) as *M. ginkgodens*; this specimen was shown to be *M. traversii* by van Helden et al. (2002). Since then two strandings of *M. ginkgodens* have occured in New Zealand, the first at Onaero Beach, Taranaki in 2003 and the second at Puponga, Golden Bay 2004. Both animals were mature males measuring 4.8 m.

3. Population size
no entries.

4. Biology and Behaviour
The Ginkgo-toothed Beaked Whale is very poorly known. Nothing is known about its behavior, but it is likely to be unobtrusive. Probably *Mesoplodon gingkodens* occurs in small groups. The lack of scarring suggests little or no aggression between males; at least, the teeth are not involved in fights. Confusion is most likely with other beaked whales, such as Blainville's, Andrews' Hubbs', Stejneger's and Cuvier's Beaked Whales (Carwardine, 1995).

5. Migration
no entries.

6. Threats
A few animals have been taken off the coast of Japan (Jefferson et al. 1993). For recommendations on southeast Asian stocks, see Perrin et al. (1996) in Appendix 2.

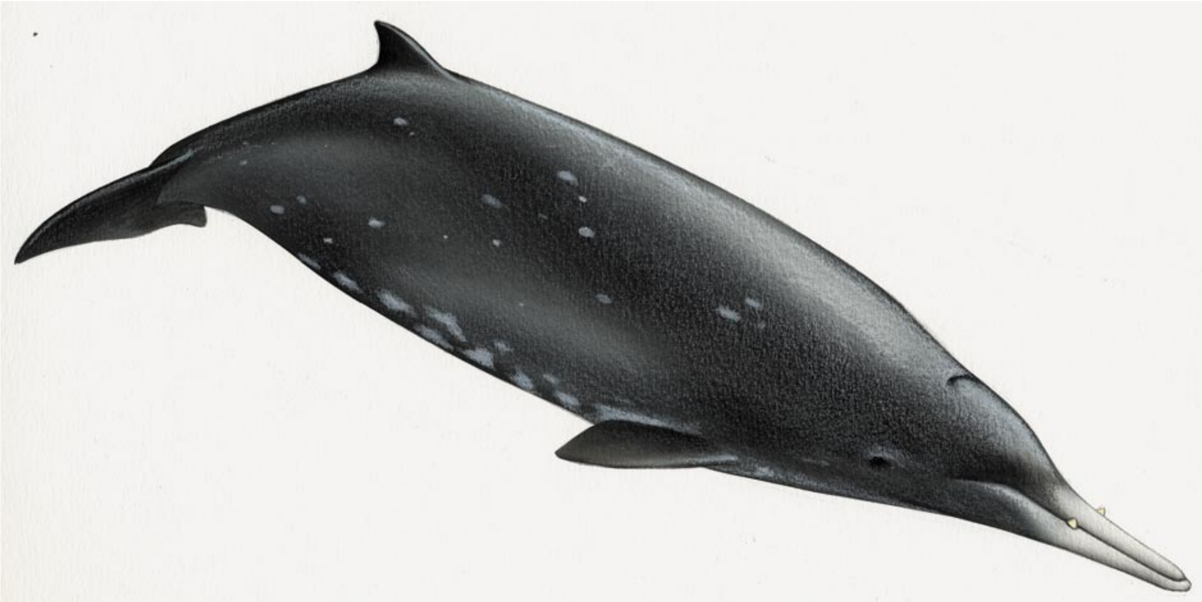
7. Remarks
IUCN status: "Data Deficient". The species is not listed by CMS.

8. Sources and further information
see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

Kindly reviewed by Anton van Helden, Museum of New Zealand, Wellington.

5.37 Mesoplodon grayi (von Haast, 1876)

English: Gray's beaked whale
German: Gray-Zweizahnwal
Spanish: Zifio de Gray
French: Mésoplodon de Gray



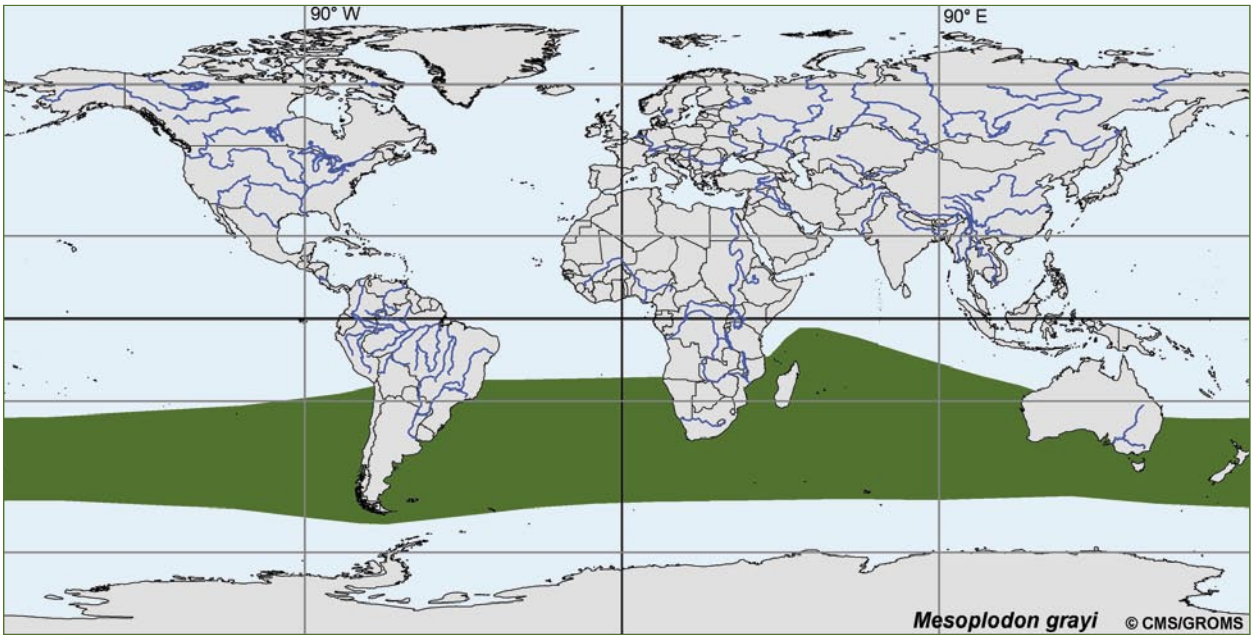
Drawing of Mesoplodon grayi © Wurtz-Artescienza.

1. Description

Adults are dark grey, with pale patches on the undersides. The small head leads to a narrow beak which becomes white in adulthood. Two small, triangular teeth erupt from the front of the lower jaw in both sexes. There are 17–22 pairs of small teeth in the upper jaw. The longest male ever recorded measured 4.7 m, with the longest female measuring 5.6 m (Ward, 2001).

2. Distribution

Gray's beaked whale is circumglobal in temperate waters of the southern hemisphere, with specimen records from Argentina (Tierra del Fuego, Chubut, and Buenos Aires), Falkland Islands / Islas Malvinas, Cape Province in South Africa, 31°S, 47°E, in the Indian Ocean, Western Australia, South Australia, Victoria, New South Wales, Tasmania, New Zealand, Chatham



Distribution of Mesoplodon grayi (mod. from Carwardine, 1995; Pitman, 2002; © CMS/GROMS). The species is found in temperate waters of the southern hemisphere (Pitman, 2002).

Islands, Paracas in Peru, and the Estrecho de Magallanes in Chile. Also (vagrant?) in North Atlantic, where there was one stranding in the Netherlands (Rice, 1998). There is one recent record from Brazil (Soto and Vega, 1997), which extends the northern limit of the distribution.

3. Population size

no entries.

4. Biology and Behaviour

There have been a number of confirmed sightings, mainly from the southern Indian Ocean, although most available information is from stranded animals. From the little evidence available, this species may be social, which is unusual for beaked whales (but see other species accounts). Females and juveniles are probably impossible to identify at sea. The limited number of sightings suggests that *Mesoplodon grayi* may be more conspicuous at the surface than other beaked whales: it seems to be more active and *may* live in larger groups. Most animals were observed singly, in pairs, and in small groups, but a mass stranding of 28 animals in the Chatham Islands, east of New Zealand, in 1874 suggests that fairly large numbers may be encountered together (Carwardine, 1995).

According to Pitman (2002) it is one of the more widespread and common beaked whales in the Southern ocean.

There is no recent literature on the behaviour of this species.

5. Migration

no entries.

6. Threats

no entries.

7. Remarks

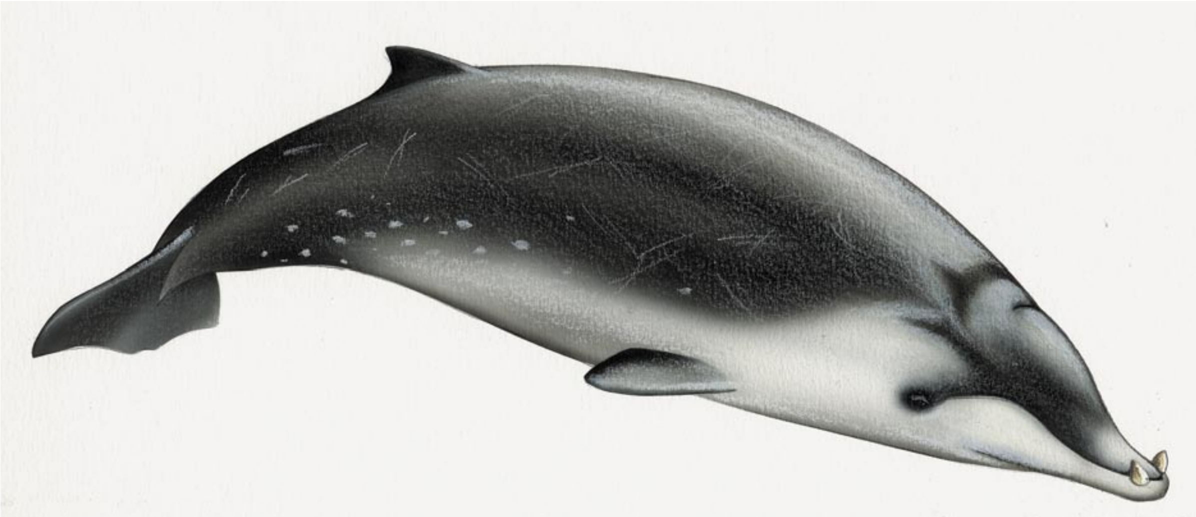
The species is categorised as "Data Deficient" by the IUCN. Gray's beaked whale is not listed by CMS, but because it also occurs in southern South America, the recommendations listed in Hucke-Gaete (2000) also apply (see Appendix 1).

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.38 Mesoplodon hectori (Gray, 1871)

English: Hector's beaked whale
German: Hector Schnabelwal
Spanish: Zifio de Héctor
French: Mésoplodon de Hector



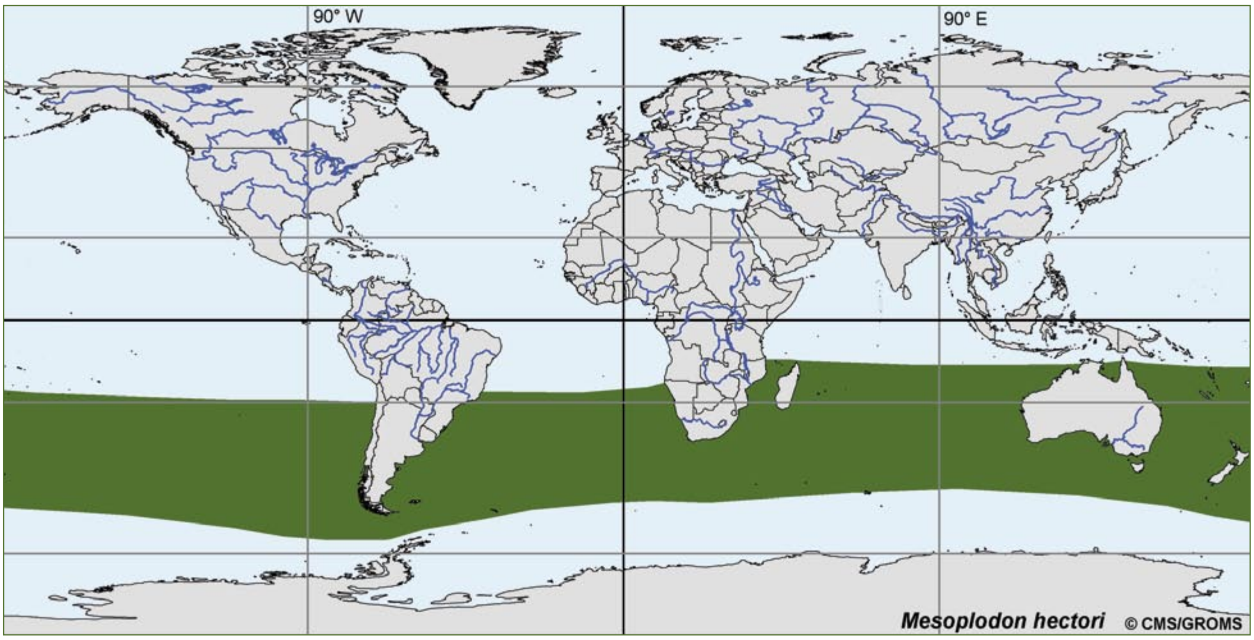
Drawing of Mesoplodon hectori © Wurtz-Artescienza.

1. Description

Hector's Beaked Whale appears to be dark grey to brown, with pale grey undersides. Scratches and scars are common on the flanks, while a small triangular tooth is found exposed on either side of the lower jaw near the tip. The longest stranded male was 4.3 m, with the longest female slightly bigger at 4.4 m (Ward, 2001).

2. Distribution

Hector's beaked whale is circumglobal in temperate waters of the southern hemisphere. Specimens were recorded from Tierra del Fuego and Chubut in Argentina, the Falkland Islands / Islas Malvinas, Rio Grande do Sul in Brazil, Cape Province in South Africa, Tasmania, North Island and South Island in New Zealand, and Isla Navarino in Chile (Rice, 1998).



Distribution of Mesoplodon hectori (mod. from Carwardine, 1995; © CMS/GROMS). The species is circumpolar in temperate waters of the southern hemisphere (Pitman, 2002).

Previously, it was supposed that this species may also be vagrant in Southern California, where there were several strandings and sightings from 1975 to 1979 (Rice, 1998). However, the California specimens have recently been found to belong to the new species *Mesoplodon perrini* found in the Eastern North Pacific (Dalebout et al. 2000; Dalebout, pers. comm.; Dalebout et al. 2002), which would confine *M. hectori* to the Southern Hemisphere.

3. Population size

no entries.

4. Biology and Behaviour

According to Carwardine (1995), with only 2 probable sightings in the wild, there is little information on behavior. However, this species may be unusual for a *Mesoplodon* because, in both instances, one of the animals seemed inquisitive and actually approached the boat. If this is normal behavior, it seems strange that there have not been more sightings (unless the species is rare). Pairs may be the typical group size. Hector's beaked whales are known to feed on squid (Jefferson et al. 1993).

There is no recent literature on this species.

5. Migration

no entries.

6. Threats

no entries.

7. Remarks

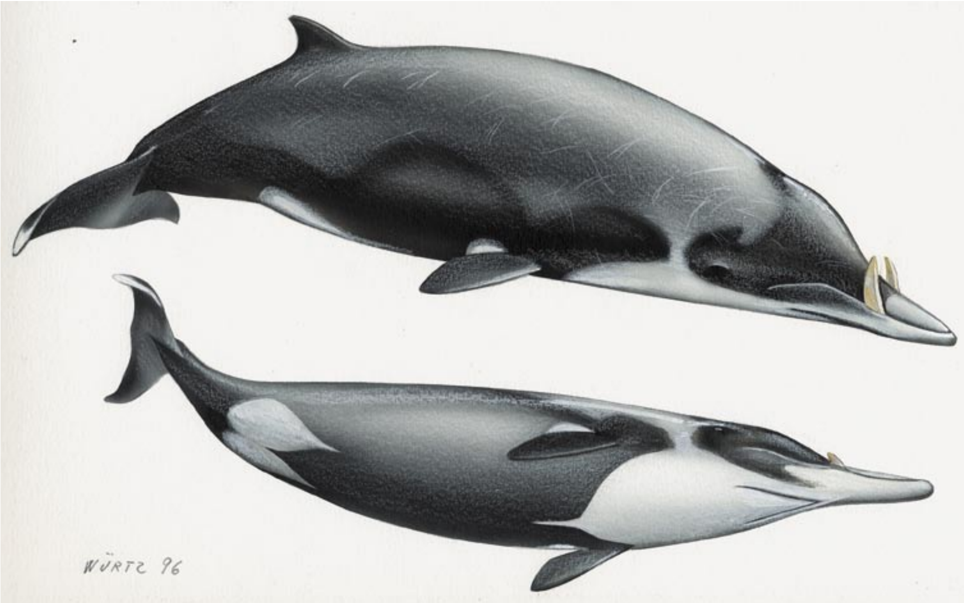
Categorised as "Data Deficient" by the IUCN. Hector's beaked whale is not listed by CMS, but see recommendations for southern South American cetaceans in Hucke-Gaete (2000) in Appendix 1.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).-

5.39 Mesoplodon layardii (Gray, 1865)

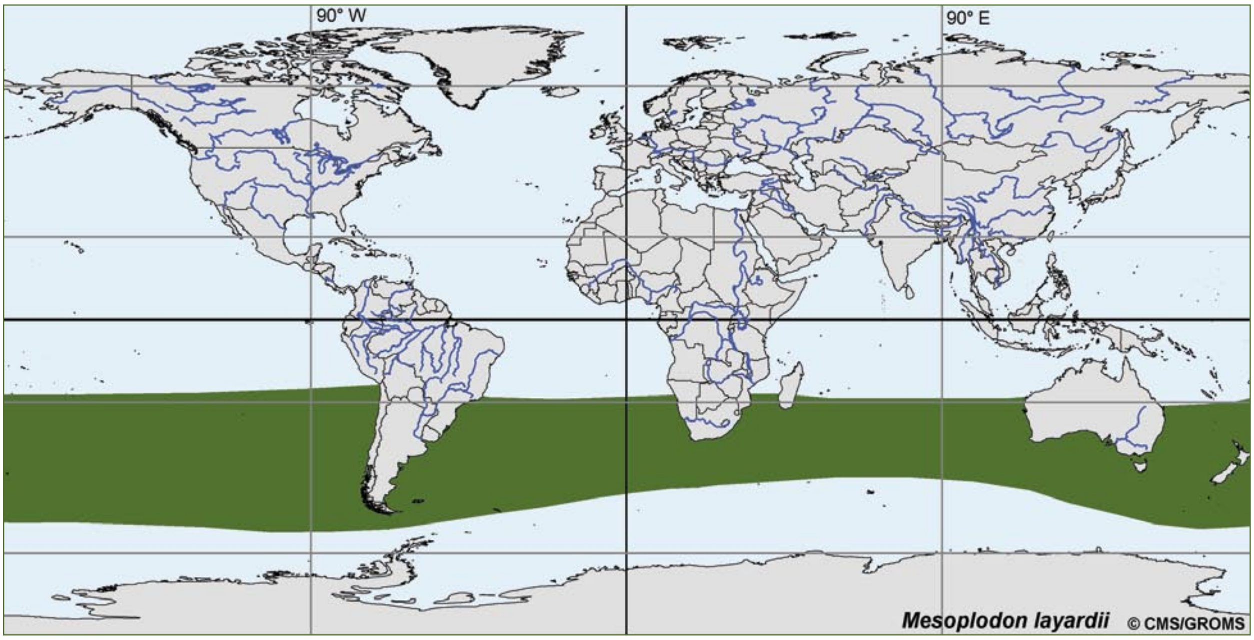
English: Layard's beaked whale, Strap-toothed whale
German: Layard-Zweizahnwal
Spanish: Zifio de Layard
French: Mésoplodon de Layard



Drawing of Mesoplodon layardii © Wurtz-Artescienza.

1. Description

Adults are mainly black with patches of grey and white that largely occur in the genital area, around the front of the upper jaw, the lower jaw, throat and chest. There is a grey blaze from the melon to almost two-thirds of the way to the dorsal fin. Teeth erupt in males only, extending from the lower jaw to curve over the upper, preventing it from opening fully. This does not, however, seem to interfere with feeding. The longest female recorded measured 6.1 m, while the longest male reached 5.8 m (Ward, 2001).



Distribution of Mesoplodon layardii (mod. from Carwardine, 1995; © CMS/GROMS). M. layardii is circumglobal in temperate and sub-Antarctic southern waters (Pitman, 2002).

2. Distribution

Layard's beaked whale occurs throughout the Southern Ocean; it has been recorded from Tierra del Fuego and Chubut in Argentina, Uruguay, the Falkland Islands / lslas Malvinas, Namibia, Cape Province, Iles Kerguélen, Western Australia, South Australia, Victoria, New South Wales, Queensland, Tasmania, New Zealand, and Isla Navarino and the Estrecho de Magallanes in Chile (Rice, 1998).

The northernmost records of Layard's beaked whale stem from strandings along the southern Brazilian coast (31-32°S; Pinedo et al. 2002). According to Pitman (2002) it is one of the more widespread and common beaked whales in the Southern ocean.

3. Population size

no entries.

4. Biology and Behaviour

One of the largest of the beaked whales, the Strap-toothed Whale is also one of the few *Mesoplodon* species that can be readily identified at sea. It is rarely seen in the wild, where it may bask at the surface on calm, sunny days. Generally the animals are hard to approach, especially in large vessels. Their flukes do not normally show above the surface at the start of a dive. Limited observations suggest that Strap-toothed whales sink slowly beneath the surface, barely creating a ripple, then rise and blow again 150-200 m away. Typical dive time is 10 to 15 minutes (Carwardine, 1995).

Food: The food habits of strap-toothed whales were examined in detail by Sekiguchi et al. (1996) using stomach contents from 14 stranded whales found on South African and New Zealand coasts. Although a few unidentified fish otoliths and crustacean remains were found in two of these stomachs, 24 species of oceanic squids (some of which occur at a great depth) accounted for 94.8 % of counted prey items. *Histioteuthis* sp. and *Taonius pavo* were the predominant prey species. The presence of sub-Antarctic squid species suggested a northward migration to South African waters in late summer / autumn.

Sekiguchi et al. (1996) also compared prey sizes between males with fully grown strap-teeth and females / immature males without erupted teeth. Although females / immature males ate longer squids than males, there was no significant difference in estimated squid weights eaten by both groups. The presence of fully-erupted teeth in adult males, therefore, did not seem to influence the size of prey ingested, even though an adult male could only open its jaws about half as wide as a female.

5. Migration

no entries.

6. Threats

No exploitation of this species has been reported (Jefferson et al. 1993).

7. Remarks

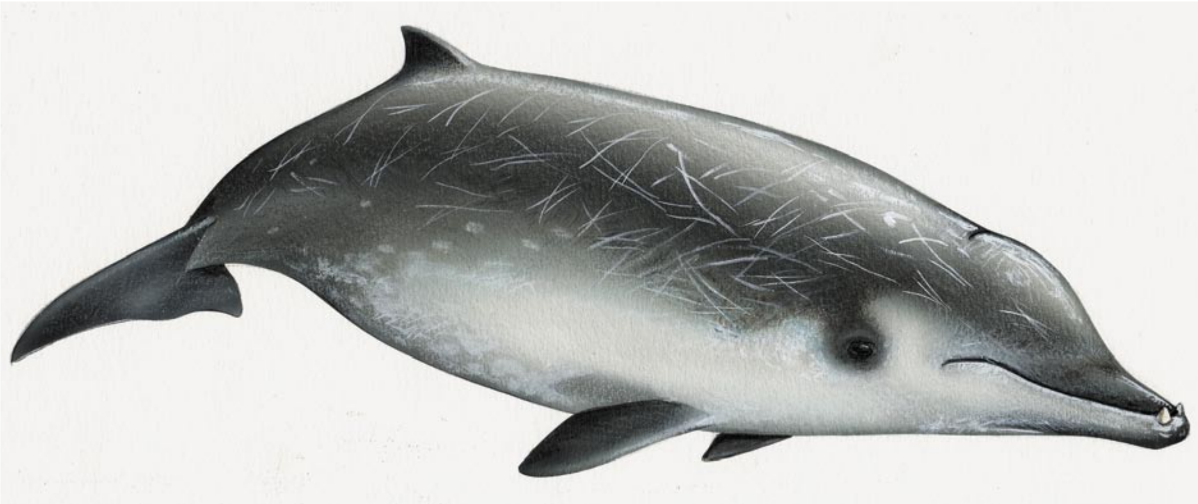
IUCN status: "Data Deficient". The species is not listed by CMS, but recommendations listed in Hucke-Gaete (2000) apply (see Appendix 1).

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources" (page 154).

5.40 Mesoplodon mirus (True, 1913)

English: True's beaked whale
German: True-Zweizahnwal
Spanish: Zifio de True
French: Mésoplodon de True



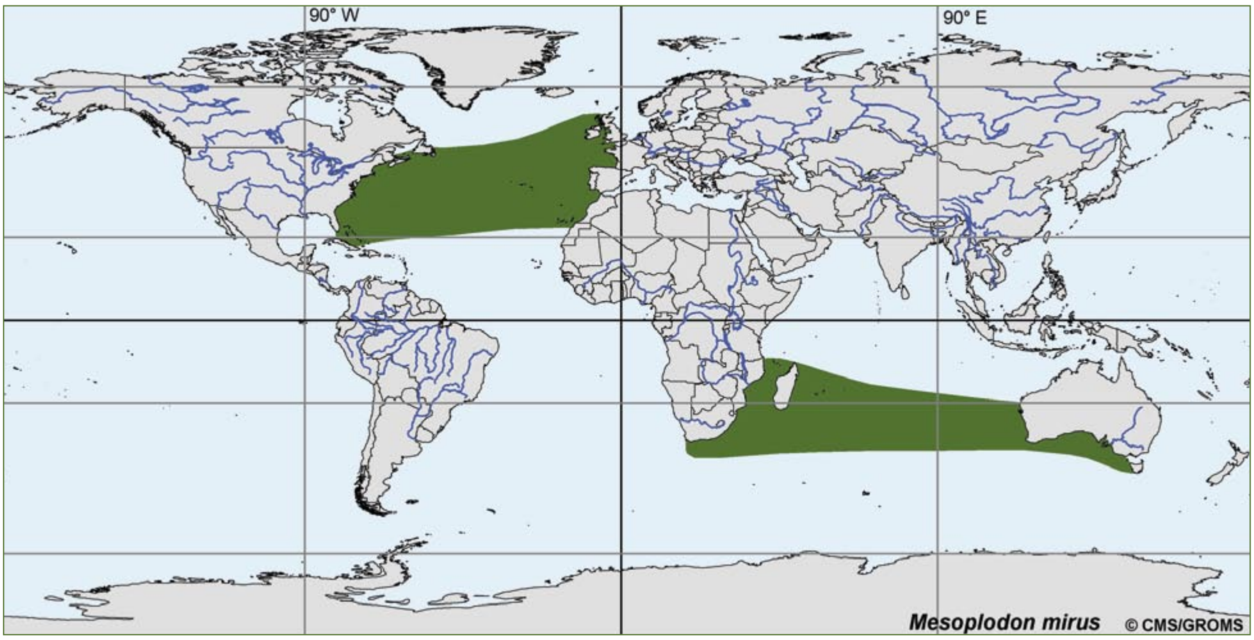
Drawing of Mesoplodon mirus © Wurtz-Artescienza.

1. Description

True's Beaked Whales from the Northern Hemisphere are grey fading to light grey on the undersides. Adults have a dark ring around the eye and some areas of white. Southern Hemisphere adults have a white area trailing backwards from the dorsal fin, a darker, flecked belly, and the tip of the beak becomes white. Scratches and scars appear on all animals, and a small tooth is exposed either side of the lower jaw in males. The largest female documented measured 5.1 m and weighed 1,400 kg; the largest male measured 5.3 m (Ward, 2001).

2. Distribution

True's beaked whale is found in the North Atlantic from Nova Scotia and Ireland south to Florida, San Salvador Island in the Bahamas, and Islas Canarias (an often repeated record from the outer Hebrides Islands



Distribution of Mesoplodon mirus (mod. from Carwardine, 1995; © CMS/GROMS). This species is found in the warm temperate North Atlantic and southern Indian Ocean. (Pitman, 2002).

in Scotland was based on a misidentified *Ziphius cavirostris*). In the Southern Hemisphere it is known from Cape Province in South Africa, Western Australia, and Victoria (Rice, 1998).

True's beaked whales were believed to be found only in the North Atlantic until a specimen was discovered along the Indian Ocean coast of South Africa in 1959. Several other southern hemisphere records were noted since then, from South Africa, Australia, and an unconfirmed report from New Zealand. These may represent geographically separate stocks or, alternatively, the range may be more widespread than the few records suggest. Most strandings stem from the western North Atlantic, but a few from the eastern side: mainly from the west coast of Ireland, but also Britain, France, and the Canary Islands. Thus, the species may be associated with the Gulf Stream (Carwardine, 1995; de Buffrénil, 1995a).

The species does not seem to occur within 30° north or south of the equator, which may indicate that the northern and the southern populations are separate, which is supported by slight morphological differences. Since there are only about 20 stranding records worldwide, the species seems to be very rare (de Buffrénil, 1995a).

3. Population size

no entries.

4. Biology and Behaviour

Habitat: Known mainly from stranded specimens, *M. mirus* is probably pelagic, but it can occasionally be seen in coastal waters (Houston, 1990a). Although its preferred habitat is unknown, de Buffrénil (1995a and references therein) suggests that due to its size and by analogy to other *Mesoplodon* species, it is most likely a pelagic animal. This is supported by the fact that no observations were made close to shore and that stranding events are very rare.

Behaviour: Until 1993, *Mesoplodon mirus* had never been positively identified in the wild, so nothing was known about its behavior (Carwardine,1995). However, on 29 May 1993, Tove (1995) observed a pod of three True's beaked whales at sea. He successfully tracked the animals for ten to fifteen minutes, obtaining numerous photographs that document live coloration and surface swimming habits. These observations appear to represent the first of this kind available for the species. The animals were first sighted around 1300 hours at 35°44'45"N, 75°17'30"W, which is approximately 32 nm southeast of Hatteras Inlet, North Carolina. The location was in about 600 fathoms of water, but along a very steep portion of the continental shelf that drops rapidly to just over 1,000 fathoms before levelling out. Upon discovery, the pod was swimming slowly (similar to 5 km/h) to the SSW, roughly parallel with the fall line of the slope. The location was well within the Gulf Stream, but at an atypically cooler than normal water temperature of 25.4°C.

Lack of further sightings may reflect identification difficulties at sea. Scratches and scars on back and sides indicate fighting between males. The species is likely to be a deep diver (Carwardine,1995).

Food: According to Jefferson et al. (1993), stranded animals had squid in their stomachs.

5. Migration

no entries.

6. Threats

The species is not known to have been commercially exploited (Houston, 1990a; Jefferson et al. 1993). However, there are reported by-catches: The pelagic drift gillnet fishery off the US east coast recorded 46 beaked whale mortalities between 1989 and 1998, 4 of which were True's beaked whales (Waring, 2001).

7. Remarks

Categorised as "Data Deficient" by the IUCN. True's beaked whale is not listed by CMS.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.41 Mesoplodon perrini (Dalebout, Mead, Baker, Baker and van Helden, 2002)

English: Perrin's beaked whale
German: Perrin's-Zweizahnwal
Spanish: Zifio de Perrin
French: Mésoplodon de Perrin

1. Description

Dalebout et al. (2002) describe *Mesoplodon perrini*, a new species of beaked whale, on the basis of five animals stranded on the coast of California (between 33°55'N, 117°15'W and 36°37'N, 121°55'W) from May, 1975 to September, 1997. Four of these animals were initially identified as Hector's beaked whales (*M. hectori*) based on cranial morphology (Mead, 1989). A fifth specimen was initially identified as a neonate Cuvier's beaked whale (*Ziphius cavirostris*) based on external features.

These specimens were first recognised as representatives of an undescribed species through phylogenetic analysis of mitochondrial (mt) DNA control region and cytochrome b sequence data.

Although similar morphologically, the genetic data do not support a close evolutionary relationship between *M. perrini* and *M. hectori*. Instead, these data suggest a possible sister-species relationship with the lesser beaked whale *M. peruvianus*.

Sightings of two small beaked whales off California in the 1970's which were tentatively identified as *M. hectori* are also likely to be *M. perrini*.

Dalebout et al. (2002) suggest that *M. hectori* is confined to the Southern Hemisphere, while *M. perrini* is known to date only from the North Pacific.

3. Sources and further Information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.42 Mesoplodon peruvianus (Reyes, Mead and Van Waerebeek, 1991)

English: Peruvian beaked whale
German: Peruanischer Schnabelwal
Spanish: Ballena picuda
French: Mésoplodon pygmée

Drawing of Mesoplodon peruvianus © Wurtz-Artescienza.

1. Description

M. peruvianus is the smallest of all *Mesoplodon* species. It has a small, triangular dorsal fin and a short, narrow beak. The head is also narrow and the melon not as bulbous as in the other species. There are two teeth on the lower jaw. Peruvian beaked whales are dark grey in colour, which fades to light grey on the undersides. Body size is between 3.4-3.7 m in length (Ward, 2001).

Distribution of Mesoplodon peruvianus (mod. from Carwardine, 1995; © CMS/GROMS). Peruvian beaked whales are found in the eastern Pacific, from northern Mexico to northern Chile (Pitman, 2002).

Pitman et al. (1987) described the appearance and distribution of a distinctive but unidentified species of *Mesoplodon* known only from two dozen at-sea sightings in the eastern tropical Pacific Ocean (ETP)—an animal referred to as *Mesoplodon* species "A". Pitman and Lynn (2001) recently updated biological observations on Mesoplodon. sp. "A" and provide new information on its appearance and morphometrics, including body-length estimates obtained from aerial photogrammetry, and a description of tooth placement in adult males based on observations and photographs of live animals. Based on these findings, they propose that M. sp. "A" is in fact *Mesoplodon peruvianus*.

2. Distribution

The Peruvian beaked whale was newly discovered as recently as 1991 and is only known from Bahia de Ia Paz in the southwestern Golfo de California, and from the coast of Peru between Playa Paraiso (11°12'S) and San Juan de Marcona (15°19'S) (Rice, 1998).

However, the distributional range may be larger than shown on the map, and span the whole of the Pacific as Baker and Van Helden (1999) report on a stranded specimen from the coast of New Zealand.

3. Population size

no entries.

4. Biology and Behaviour

Field identification is likely to be very difficult. All current information is based on only a handful of observations. Strandings have been of lone animals, but almost all possible sightings are of pairs (with one exception, when 2 adults and a calf were seen together). Confusion of Peruvian beaked whales is most likely with Hector's beaked whale, which also occurs in pairs; nothing is known about behavioral differences. Peruvian beaked whales observed in 5 possible sightings in 1986 and 1988 were readily approachable (Carwardine, 1995).

5. Migration

no entries.

6. Threats

Peruvian beaked whales are taken in the driftnet fishery for sharks off Peru (Jefferson et al. 1993).

7. Remarks

The species is categorised as "Data Deficient" by the IUCN. *Mesoplodon peruvianus* is not listed by CMS.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.43 Mesoplodon stejnegeri (True, 1885)

English: Stejneger's beaked whale
German: Stejneger-Zweizahnwal
Spanish: Zifio de Stejneger
French: Mésoplodon de Stejneger

Drawing of Mesoplodon stejnegeri © Wurtz-Artescienza.

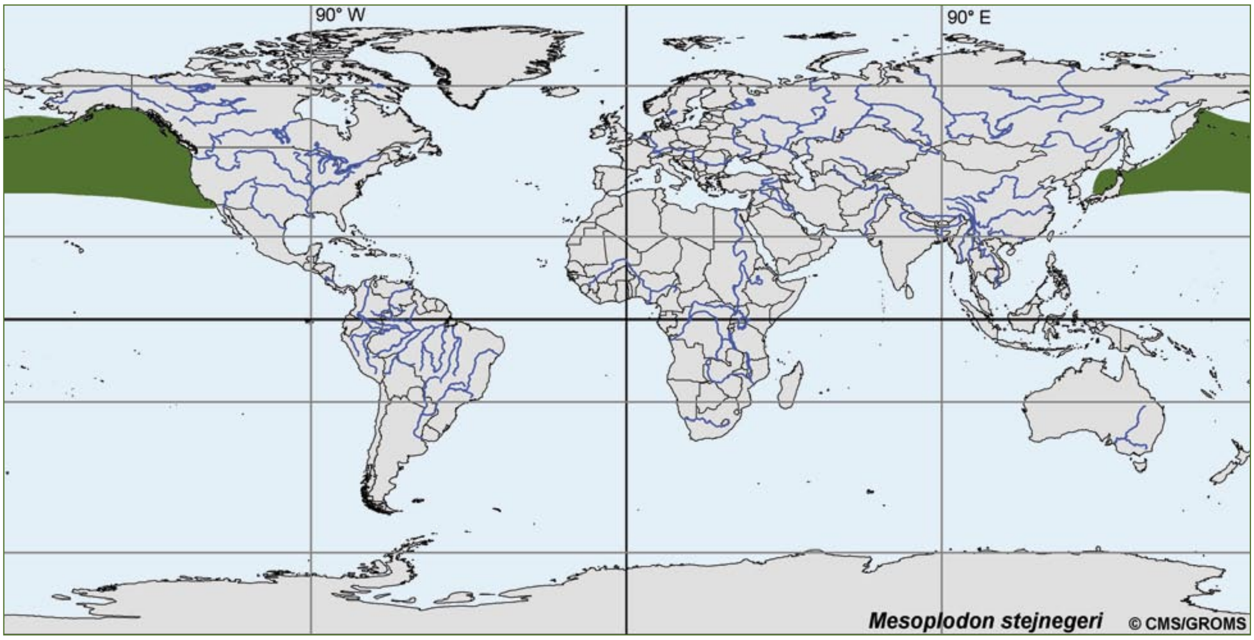
1. Description

Few animals have been seen alive. Stejneger's Beaked Whale appears to be dark above and pale below, with the head and neck areas being paler. In adult males two large erupted teeth point forwards near the peak of the arched lower jaw. Both the largest male and largest female specimens measured 5.2 m (Ward, 2001).

2. Distribution

Stejneger's beaked whale ranges in subarctic waters of the North Pacific from the Bering Sea south to Japan and central California (Rice, 1998). The center of its distribution seems to be the Aleutian Islands, where *M. stejnegeri* has been known to strand in small groups. There are also sighting records from the central Aleutian Islands (Mead, 1989 and references therein).

Although *M. stejnegeri* is sometimes known as the Bering Sea beaked whale, it is worth noting that all of the records from the Bering Sea are on the northern side of the Aleutian Islands with the exceptions of three. Of those three, two are records from the northern side of the tip of the Alaska Peninsula and one is from Saint Paul Island, which is on the southern edge



Distribution of Mesoplodon stejnegeri (mod. from Carwardine, 1995; © CMS/GROMS). M. stejnegeri lives in the sub-Arctic and temperate north Pacific from California to Japan (Pitman, 2002).

of the Bering Sea shelf. It is more likely that this species frequents the Aleutian Basin and the Aleutian Trench rather than the shallow waters of the northern or eastern Bering Sea (Mead, 1989 and references therein).

3. Population size

no entries.

4. Biology and Behaviour

Stejneger's Beaked Whale is inconspicuous at sea and seldom seen alive. It is probably rare, though it may simply have escaped notice in areas where there has been little research work. Females and young males have no erupted teeth and are probably impossible to distinguish from other *Mesoplodon* species. Mature males are distinctive, with 2 massive, laterally compressed teeth (Carwardine, 1995).

Schooling: Small groups sometimes travel abreast, almost touching one another, and may surface and submerge in unison. There are reports of 5 or 6 shallow dives, followed by long dives of 10 to 15 minutes. Diving involves a slow, casual roll at the surface. Groups usually include both small and large animals, suggesting a mixing of ages and/or sexes (Carwardine, 1995). A report by Walker and Hanson (1999) also supports the hypothesis that Stejneger's beaked whales travel in groups, as 4 animals stranded within short range of one another at Kuluk Bay, Adak Island (51°54'N, 176°34'W) in August 1994. There are no literature reports on further sightings at sea or migratory behavior.

5. Migration

no entries.

6. Threats

Several Stejneger's beaked whales are known to have been taken in salmon driftnets off Japan, and there have probably been occasional direct catches of this species off Japan and possibly elsewhere (Jefferson et al. 1993).

7. Remarks

IUCN status: "Data Deficient". The species is not listed by CMS.

8. Sources and further information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

5.44 Mesoplodon traversii (Gray, 1874)

English: Spade-toothed whale
German: Travers-Zweizahnwal
Spanish: Zifio de Travers
French: Baleine à bec de Travers

(formerly known as Mesoplodon bahamondi, Reyes, Van Waerebeek, Cárdenas and Yañez, 1995)

1. Description

Only 3 specimens were found so far in total and no description is available. One of the skulls found might have belonged to an animal ca. 5.5 m long (Ward, 2001).

2. Distribution

Isla Robinson Crusoe (Isla Más a Tierra) in the Islas Juan Fernández, Chile (Rice, 1998), and two new specimens were found on New Zealand coasts (M. Dalebout, pers. com.). The species is now known as *Mesoplodon traversii*, the name originally given to the first specimen described from New Zealand in 1874 (van Helden et al. 2002).

The species is categorised as "Data Deficient" by the IUCN and is not listed by CMS (see "selected web-sites").

3. Sources and further Information

see "Genus *Mesoplodon* – Beaked Whales: Introduction and Sources"(page 154).

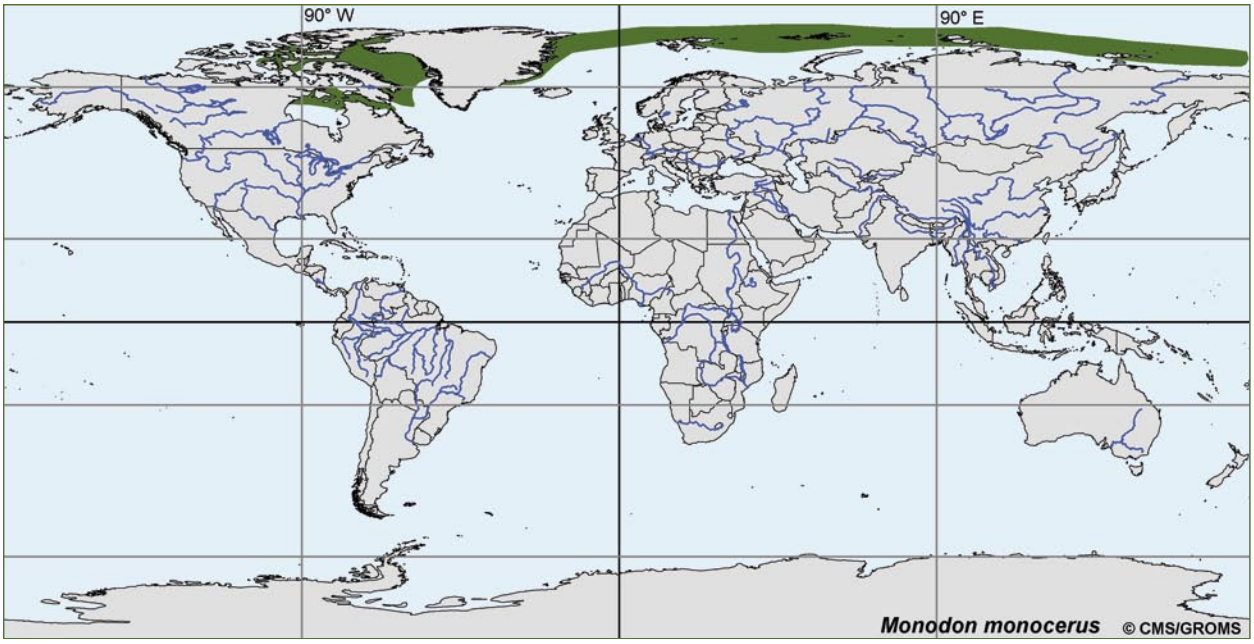
5.4 Monodon monoceros (Linnaeus, 1756)

English: Narwhal
German: Narwal
Spanish: Narval
French: Narval

Drawing of Monodon monoceros © Wurtz-Artescienza.

1. Description

Adult narwhals are completely mottled on the dorsum with increasingly white fields on the ventral side. Old males only maintain a narrow dark spotted pattern on the top of the back, whereas the rest of the body is white. As opposed to other cetaceans, the tail fluke is concave and the dorsal fin is replaced by a low ridge. In males, the left of two elongated maxillary teeth grows and protrudes through the maxillary bones and skin of the rostrum. During growth, the tusk spirals and grooves to the left. Females may sometimes attain a tusk as well, some males may lack even one whereas others may have two tusks. The largest tusk measured 267 cm, normal size is 200 cm. The tusk is believed to be a secondary sexual character determining social rank among males. Body length is 400 and 475 cm for adult males and females, respectively, and mass rea-



Narwhal distribution (mod. from Heide-Jørgensen, 2002; © CMS/GROMS).

ches 1000 kg in females and 1600 kg in males (Heide-Jørgensen, 2002).
According to Hay and Mansfield (1989) the narwhal has at present a discontinuous circumpolar range, since it is not abundant in the central Canadian Arctic and is rarely found in the western Canadian Arctic and in Alaskan and Siberian waters. According to Born (1994) it is unlikely that narwhals from the eastern Canadian Arctic have intensive contact with animals from eastern Greenland.

Palsboll et al. (1997) determined the nucleotide sequence of the first 287 base pairs in the mitochondrial control region from 74 narwhals collected in the North-West Atlantic. Their results suggest a recent expansion in abundance from a small founding population. Despite the low degree of variation, frequencies of the common haplotypes differed markedly between areas. This indicates isolation, even between geographically close areas, as well as fidelity to specific summer and autumn feeding grounds.

2. Distribution

The narwhal is discontinuously circumpolar and arctic. It is observed very infrequently south of 65°N in Greenland. However, during spring, when distributional ranges may overlap north of Greenland, its range may become circumpolar (Born, 1994). The main part of the population occurs in the eastern Canadian Arctic and west Greenland. Observations by Gjertz (1991) suggest that on Svalbard narwhals concentrate in the north-west area of Spitzbergen.

In the eastern Canadian Arctic the range extends from Lancaster Sound, and Kane Basin, south through Baffin Bay and Davis Strait as far as Cumberland Sound on Baffin Island and Disko off western Greenland; A possibly isolated population lives in Foxe Basin and northern Hudson Bay. Along the east coast of Greenland it ranges from Nordostrundingen (81°N) south to Umiivik (64°N), thence eastwards in the high arctic pack ice through the Greenland, Barents, Kara, Laptev and East Siberian Seas to about 165°E, and from about 85°N southward to Svalbard, Zemlya Frantsa Iosifa, Novaya Zemlya, Severnaya Zemlya, Novosibirskiye Ostrova, and Ostrova De-Longa (157°E) (Rice, 1998).

Narwhals are vagrant south to the coast of Labrador (Rice, 1998), rare to accidental south to Iceland, the Norwegian Sea, the North Sea (south to the British Isles, The Netherlands and Germany), the White Sea, and the arctic coast of mainland Eurasia, and east into the Chukchi Sea and the Bering Sea, as far south as Komandorskiye Ostrova and the north side of the Alaska peninsula (Rice, 1998).

3. Population size

According to IWC (2000), Hay and Mansfield (1989) and Strong (1988), the most recent population surveys were carried out in 1984 and yielded 18,000 narwhals in the four major summering areas south of Lancaster Sound (Eclipse Sound, Admiralty Inlet, Prince Regent Inlet and Peel Sound). A further 1,000 narwhals were estimated for the Repulse Bay – Frozen Strait area. Koski and Davis (cited in Born, 1994) recorded 34,000 narwhals in parts of Baffin Bay after the end of winter.

Hay and Mansfield (1989) suggest from unpublished data, that in 1971 the Thule-district narwhal population in north-west Greenland was estimated ranging between 1,500-2,500. A more recent land-based count in 1984 (Born, 1994) showed the population in Inglefield Bay to number at least 4,000.

In the Eurasian sector of the arctic the only known estimate of narwhal numbers is from Scoreby Sound and Kung Oscar Fjord in eastern Greenland. A conservative figure of only 176 was obtained from an aerial line-transect survey carried out in September 1983 by F. Larsen (cited in Hay and Mansfield, 1989). Born (1994) confirms that more detailed data is lacking. He suggests that in this sector, narwhals prefer areas distant from the coast and may number at most a few thousand individuals.

4. Biology and Behaviour

Habitat: Narwhals are considered deep-water cetaceans, associated with the pack ice (Hay and Mansfield, 1989). Other investigators, however, dispute their characterization as deep-water species, noting that they occur in waters of different depths. Born (1994) suggests that the occurrence of narwhals and belugas is mutually exclusive, since summering and wintering grounds differ both in location and time, which seems to exclude competition for food. When both species do occur in the same areas, they seem to reduce competition by foraging at different depths.

Schooling: Most pods consist of 2-10 individuals but they may aggregate to form larger herds of hundreds or even thousands of individuals (Jefferson et al. 1993). According to Hay (1985) segregation by age and sex within this population is evident, with summering groups consisting of mature females with calves, immature and maturing males, and large mature males.

Reproduction: The gestation period is estimated to be 15.3 months. The season of conceptions is March to May and calving occurs during July and August. Since the lactation period exceeds 12 months, the interval between successive conceptions is usually three years, but about 20% of females conceive at the first breeding season following birth of their calves. The annual population birth rate is calculated to be about 0.07. The basic life history features of the narwhal are similar to those of other medium-sized toothed whales (Hay, 1985).

Food: Prey items include Arctic cod (*Boreogadus saida*) and polar cod (*Arctogadus glacialis*), pelagic species associated with ice undersides. Demersal species found at great depths such as Greenland halibut (*Reinhardtius hippoglossoides*) and bottom-dwelling cephalopods are also taken (Heide-Jørgensen, 2002). Further prey items include squid (*Gonatus fabricii*), and the shrimps *Pasiphaea tarda* and *Hymenodora glacialis*. Narwhals feed heavily during migrations, but very little during the open water season (Hay and Mansfleld, 1989; Reyes, 1991 and refs. therein). Stomach content analyses suggest that these cetaceans feed over a wide range of depths, at least in the Baffin Bay area (Hay and Mansfield, 1989). The deepest recorded diving depth was 1,164 m, and dive times usually amount to 20-25 min (Heide-Jørgensen, 2002).

5. Migration

Throughout the whole year, narwhals live in close contact to the arctic pack ice (Born, 1994). They follow the distribution of the ice and move towards coastal areas when these are ice free. During freeze-up, the coastal areas are abandoned and the narwhals move offshore (Heide-Jørgensen, 2002). Observations from airplanes suggest that narwhals overwinter in small groups within heavy pack ice, whereas only a few animals were observed in loose pack ice and open water (Koski and Davis, cited in Born, 1994).

In the Eurasian sector of the Arctic, narwhals probably overwinter in the Greenland Sea and the Barents Sea, although Gray (1931, cited in Hay and Mansfield, 1989) suggested Denmark Strait as the wintering area for this population.

Turl (1987) and McLaren and Davis (cited in Hay and Mansfield, 1989) suggest that most of the population of the eastern Canadian Arctic overwinters in both open and closed pack-ice in Davis Strait, especially in the area west and south west of of Disko Island.

The regular occurrence of narwhals at Repulse Bay in north-western Hudson Strait suggests that they may overwinter there as well, or possibly in Hudson Strait where they were also observed by McLaren and Davis (Hay and Mansfield, 1989).

Narwhals display a pronounced annual migratory cycle. Hay and Mansfield (1989) summarise that after spending the winter in Davis Strait, they move northward through the pack ice, congregating in larger groups in May and June at the edge of the fast ice in the fjords of northern Baffin Island and north-western Greenland. A spectacular westward migration of several thousand narwhals through Lancaster Sound was observed by Tuck and by Greendale and Brousseau-Greendale (cited in Hay and Mansfield,1989). These narwhals migrate to the fjords of northern Baffin Island, Prince Regent Inlet, Barrow Strait, and Peel Sound.

After fast ice breaks up and disperses during late June and July, narwhals enter the fjords of northern Baffin Island and north-western Greenland in thousands. They remain there in August and September, sometimes in the bays at the heads of the fjords. Prior to the formation of new ice in October, narwhals leave the fjords and migrate southwards, appearing sporadically at locations on the east coast of Baffin Island and the west coast of Greenland. They spend the winter in the pack-ice of Davis Strait, west and south-west of Disko Island.

Recent satellite data confirm these findings. Satellite transmitters were mounted on 3 female and one male narwhal in the Melville Bay August 1994 (Anonymous, 1997). The females stayed in Melville Bay until the transmitters stopped transmission in September. The male left Melville Bay mid-October and, like the animals tagged in 1993, it headed toward deep water in Baffin Bay where it frequently dived down to 1,000 metres. In the beginning of December it was located approximately 200 km west of Disko Island.

Heide-Jørgensen and Dietz (1995) collected dive data from nine narwhals instrumented with satellite-linked dive recorders in Northwest Greenland in August-

September 1993 and 1994. Data were collected for periods ranging from a few weeks to 9 months. The narwhals made daily dives to depths of more than 500 m and frequently dived to 1,000 m or more. However, most of the time spent below the surface was in the water column at depths of between 8 and 52 m.

At summering grounds in West Greenland and Canada, narwhals moved back and forth between glacier fronts, offshore areas and neighbouring fjords (Dietz et al. 2001). When fast ice formed, the whales moved out to deeper water, usually up to 1,000 m water depth. In October, the whales moved southward toward the edge of the continental shelf where water depth increases over a short distance from 1,000 to 2,000 m. This slope in central Baffin Bay was also used as a wintering ground, and even though the whales seemed stationary in this area, they still conducted shorter movements along the steep continental slope. Narwhals satellite-tracked from Canada and West Greenland were within a few kilometres from each other at these wintering grounds. The importance of this watering ground in central Baffin Bay has also been confirmed by aerial surveys (Heide-Jørgensen, 2002).

The migratory cycle in east Greenland waters is not well known. Apparently narwhals migrate to the north and north-east into the ice fields of the Greenland Sea during May-July. Some whales migrate eastwards to the vicinity of Franz Josef Land and as far east as the new Siberian Islands. A few whales also visit the fjords of north-western Greenland. Their southward migrations in autumn lead them to the southern Greenland Sea, Barents Sea and Danmark Strait (Hay and Mansfield, 1989).

6. Threats

Direct catch: The narwhal has been hunted since the earliest times by the Inuit (Reyes, 1991). According to this source, the annual hunting mortality may be in the order of 1,000 animals to day. Heide-Jørgensen (2002) estimates annual catch rates at 550 and 280 between 1993-1995 in Greenland and Canada, respectively. According to Reeves (1992) Inuit in Canada kill several hundred narwhals in most years. While male narwhals composed most of the landed catch, annual harvest statistics underestimated the total numbers of narwhals killed due primarily to the non-reporting of struck and killed but lost whales. The estimated total kill of narwhals exceeded the reported landed catch by 40% (Roberge and Dunn, 1990).

Narwhals supplied various staples in the traditional subsistence economy. Today the main products are muktaaq and ivory. The large tusks of adult males are sold in the speciality souvenir market both inside Canada and in the global marketplace. The price of narwhal ivory has increased substantially over the past 25 years, with steep increases in 1967, 1972, and the late 1970s to early 1980s. Canadian narwhal ivory traditionally was exported to the United Kingdom, then often re-exported. The EEC ban closed the direct link with the United Kingdom. Consequently, new markets developed in Japan and Switzerland. Narwhal hunting remains an important source of food and cash income for residents of some coastal communities in the eastern Canadian Arctic and Greenland. The international ivory trade provided an incentive to procure large tusks, and this may have strongly influenced the nature and intensity of the hunt (Reeves, 1992).

Natural enemies: Natural enemies include Greenland sharks (*Somniosus microcephalus*), orcas, polar bears and walrus, although the mortality rates inflicted by these species do not seem to be very high (Born, 1994). The same author reports that narwhals do occasionally become trapped in fast forming ice and may die during the winter because of exhaustion in an attempt to keep the breathing hole open.

Habitat degradation: Because of their prevalence for high-density pack-ice, narwhals are susceptible to man-made as well as natural climatic changes influencing the water currents and ice formation in the Arctic (Heide-Jørgensen, 2002).

Pollution: Anthropogenic threats include pollution via heavy metals and organochlorines. Cadmium concentrations seem to be significantly higher in narwhals than in other cetaceans (Born, 1994 and references therein). Highest Cadmium concentrations were reported from narwhals living along the Canadian coast, whereas lead concentrations were higher in west Greenland animals.

According to Muir et al. (1992) narwhals had 1.4-to 8.6-fold higher ratios of tetra- and pentachlorobiphenyls to PCB-153 (2,2',4,4',5,5'-hexachlorobiphenyl), lower 4,4'-DDE/ total DDT ratios and lower proportions of trans-nonachlor to total chlordane components than reported for odontocetes living in more contaminated environments. Mean total PCB concentrations in narwhal were 6- to 15-fold lower than in dolphins from the Canadian east coast and belugas from the

St Lawrence River estuary, respectively, while PCC levels were from 4- to about 2-fold lower, and total HCH, dieldrin and total CBs differed by <2-fold. Organochlorine concentrations seem to suggest that narwhals are more exposed to volatile components of these and that they have a reduced capacity to detoxify these substances as opposed to other odontocetes (Muir et al. 1992).

Norstrom and Muir (1994) obtained data on the temporospatial distribution of PCBs and other contaminants in ringed seal, beluga, polar bear and narwhal. On a fat weight basis, the sum of DDT-related compounds (S-DDT) and PCB levels are lowest in walrus (<0.1 µg/g), followed by ringed seal, (0.1-1 µg/g range). Levels are an order of magnitude higher in beluga and narwhal (1-10 µg/g range). It appears that metabolism and excretion of S-DDT and PCBs may be less efficient in cetaceans, leading to greater biomagnification.

7. Remarks

According to Reyes (1991) the Fisheries Act of 1976 set out the Narwhal Protection Regulations for protection of habitat and management of the species in Canada. Regulations include the setting of quotas and confer total protection to mothers and calves, but due to inadequate enforcement, quotas are exceeded and nursing females are taken. Hunters are required to make full use of the carcasses and to attach tags to every tusk obtained and to every toothless female or young male killed. However, this regulation is only partially observed. There are no specific regulations for narwhal hunting in Greenland, although Inuit have themselves forbidden the use of motor boats in the narwhal hunting areas in summer. Narwhals are protected in the United States, with some exemptions for subsistence hunting. Full protection is also provided in Russia and Norway (Reyes, 1991).

At the international level, the IWC Scientific Committee (2000) recommended that genetic and telemetric studies are needed to identify stocks, and improved catch-reporting (including estimation of hunting loss) should be conducted in Canada and Greenland.

Information on life history, distribution, abundance and actual hunting loss rates are needed to assess and manage the stocks. The probable effects of pollution, industrial development and climatic change should be fully studied, since these may represent a potential threat.

The narwhal is categorized as "Insufficiently Known" (DD) by the IUCN. The species is included in Appendix II of CMS.

Range States are Canada, Denmark (Greenland), Iceland, Norway (Svarlbard), the United States (Alaska) and Russia (CMS, 1988).

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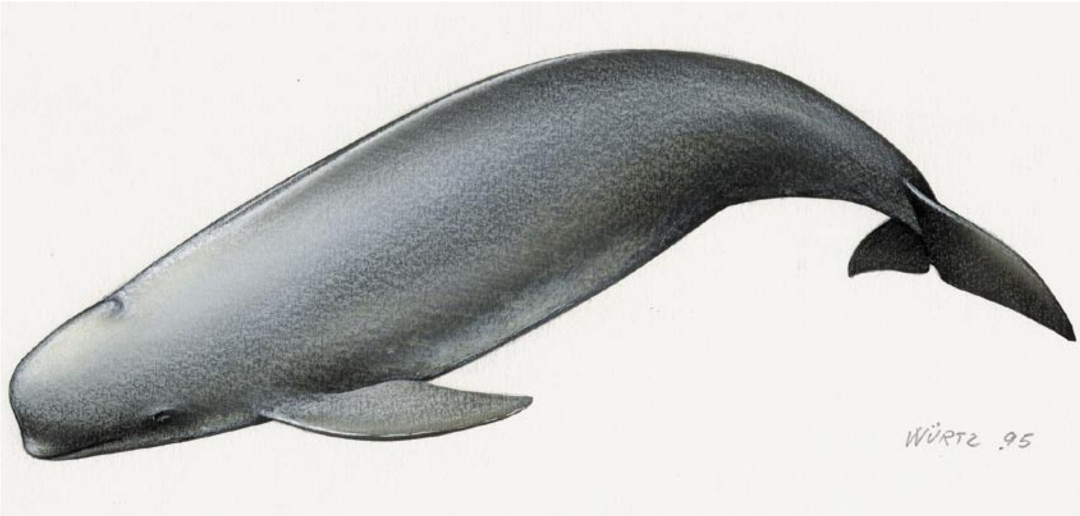
5.46 Neophocaena phocaenoides (G. Cuvier, 1829)

English: Finless porpoise
German: Indischer Schweinswal
Spanish: Marsopa lisa
French: Marsouin aptère



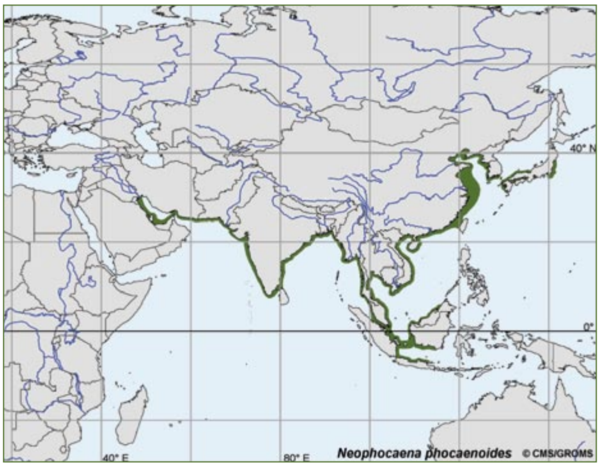
Drawing of Neophocaena phocaenoides © Wurtz-Artescienza.

1. Description

The finless porpoise is small and lacks a dorsal fin. The fin is replaced by a ridge which runs down the middle of the back. The head is rounded and there is no apparent beak. The colour is uniformly dark- to pale grey and somewhat lighter on the ventral side. Body size reaches 170 cm and mass 70 kg, with maxima of 200 cm and 100 kg (Amano, 2002).

2. Distribution

The warm, coastal Indo-Pacific waters, both fresh and marine, are home to the finless porpoise (Jefferson et al.1993). There are three well-marked regional populations which warrant subspecific rank. Even within these, significant differences in skull morphology have been found among local populations (Rice, 1998 and refs. therein, Amano, 2002):



Distribution of the three subspecies of Neophocaena phocaenoides: coastal waters and all major rivers of the Indian ocean and the Western Pacific (mod. from Amano, 2002; © CMS/GROMS).

N. p. phocaenoides inhabits coastal waters along the mainland of southern Asia from the Persian Gulf east to the South China Sea and southern part of the East China Sea; also the coasts of south-eastern Sumatra, Bangka, Belitung, Sarawak, Palawan, the Turtle Islands in the Sulu Sea, and northern Java. The species has not been found in South African waters, or anywhere else in Africa (Rice, 1998 and refs. therein). It penetrates into the Indus River for 60 km, and into the Brahmaputra River for 40 km from the mouth. (Kasuya, 1999).

N. p. sunameri (Pilleri and Gihr, 1975) ranges in coastal waters from the southern East China Sea north to the Liaodong Wan in China, Korea, and Kyushu in Japan, thence along the Pacific coast of Japan from the Seto-naikai north to Sendai-wan in northern Honshu (Rice, 1998). Five local populations are identified in Japanese waters based on skull morphology and mt DNA variability (Amano, 2002).

N. p. asiaeorientalis (Pilleri and Gihr, 1972) is found in the lower and middle reaches of the Chang Jiang (Yangtse River), where it ranges 1,600 km upstream as far as the gorges above Yichang (200 m above sea level), and including Poyang Hu and Dongting Hu and their tributaries, the Gan Jiang and the Xiang Jiang (Rice, 1998).

Finless porpoises have been seen off Bahrain but are not found along the coasts of Oman or in the Gulf of Adan off Djibouti. They seem to be absent from the African coast, Sulawesi, Halmahera and Timor, the Philippines, and the northern coast of Australia (Kasuya, 1999).

3. Population size

Estimates of abundance have been made only for specific areas in China and Japan (IWC, 2000).

Although Zhang et al. (1993) estimated the Yangtse population at about 2,700 individuals, it is unclear if this represents abundance in winter, the highest density, or the low density season of summer.

In the Inland Sea of Japan the number of porpoises observed during the breeding season (April) was 4,900. By early winter the number in the area dropped to 1,600 (Reyes, 1991, and refs. therein). Off western Kyushu, about 3,100 are estimated in the Ariake/Tachibana Bay and 200 in the Omura Bay (Kasuya, 1999 and refs. therein). Recent sightings and questionnaire surveys in the Seto Inland Sea, which is a major habitat of the finless porpoise in Japan, indicated a decrease in abundance of the species (Amano, 2002).

4. Biology and Behaviour

Habitat: The finless porpoise is mainly an inshore species, but occurs in salt and fresh water. *N. phocaenoides* appears to prefer murky or turbid conditions and can be found in warm rivers, lakes (if connected to rivers), mangroves, estuaries, deltas, and saltmarshes. It prefers areas where river and ocean waters meet (Carwardine, 1995). In the Yangtse River, finless porpoises are found up to 1,600 km from the sea and in Japanese waters, they prefer shallow depths (<50 m) and close proximity to the shore (<5 km). In the shallow East China Sea, however, proximity to the shore is not so important (Amano, 2002).

Behaviour: Like other porpoises, their behaviour tends to be not as energetic and showy as that of dolphins. They do not ride bow waves, and in some areas appear to be shy of boats. Mothers have been seen carrying calves on the denticulated area on their backs. In the Yangtse River, finless porpoises are known to leap from the water and perform "tail stands" (Jefferson et al. 1993).

Schooling: Finless porpoises are generally found as singles, pairs, or in groups of up to 12, although aggregations of up to about 50 have been reported (Jefferson et al. 1993). Recent data suggest, that the basic unit of a finless porpoise school is a mother/calf pair or two adults, and that schools of three or more individuals are aggregations of these units or of solitary individuals. Social structure seems to be underdeveloped in the species, and the mother/calf pair is probably the only stable social unit (Kasuya, 1999).

Reproduction: Reproduction in most areas has not been well studied. Reports indicate that calving in the Yangtse River occurs between April to May whereas on the Pacific coast of Japan it occurs between May and June and between November – December in western Kyushu. Animals form Kyushu live 25 years and attain sexual maturity at 4-9 years of age. Gestation lasts 11 months (Amano, 2002).

Food: Finless porpoises are reported to eat fish and shrimp in the Yangtse River, and fish, shrimp and squid in the Yellow Sea/Bohai area and off Pakistan. In Japanese waters they are known to eat fish, shrimp, squid, cuttlefish and octopus. Finless porpoises are opportunistic feeders utilising various kinds of available food items available in their habitat. Seasonal changes in the diet have not been studied (Kasuya, 1999). They also apparently ingest some plant material, including leaves and rice (Jefferson et al. 1993).

5. Migration

Available information suggests that finless porpoises are probably found year-round throughout their range, and show various degrees of seasonal movement and density change which are not well documented in most areas (Kasuya, 1999).

An annual migration is reported in the Inland Sea of Japan, where porpoises are faced with drastic seasonal changes in surface water temperature between 6°C (March) and 28°C (September). Their density is lowest (40 % of the peak season) in early winter, and starts to increase in January, reaching its peak in April. Finless porpoises migrate to and from the Pacific coast mainly through two passes at the eastern Inland Sea of Japan. From observations in the fluctuation of the proportion of mother-calf pairs, it is suggested that porpoises use the Inland Sea of Japan as a breeding ground. In summer, the animals move out to the Pacific coast (Reyes, 1991 and refs. therein; Kasuya, 1999).

Finless porpoises are known to occur year-round in Ise and Mikawa Bays with a peak abundance in April-June. They also occur year-round off western Kyushu where density is high in coastal waters less than 50 m deep in winter and spring. Along the Chinese coast, finless porpoises are present all year, but reported to have some seasonal density changes in Bohai and on the Yellow Sea coast (low in winter and high in summer/autumn). There, they apparently move from shallow to deeper water in winter. Movement of finless porpoises between the Yangtse and the ocean has yet to be confirmed (Kasuya, 1999). Akamatsu et al. (2002) recently documented daily horizontal travel distances of two finless porpoises in the Yangtse River as 94.4 km and 90.3 km.

In the Indus delta, finless porpoises move to the sea in April and return to the creeks and delta in October; here the movements of porpoises are said to follow movements of prawns (Reyes, 1991 and refs. therein).

Parsons (1998a) reports on 154 small cetacean strandings in Hong Kong territorial waters. Finless porpoises and Indo-Pacific hump-backed dolphins accounted for 77 % of these strandings. *N. phocaenoides* was more frequent in the winter. Almost a third of all finless porpoises stranded were calves. At sea finless porpoises were only sighted south of Lantau Island and were more frequently observed during the winter. Their abundance was correlated with water temperature (negatively) and salinity (positively) and also with the number of reported neonatal porpoise strandings. Seasonal distribution appears to be linked with reproductive cycles and hydrography. Diurnal patterns and tidal state seem to affect abundance (Parsons, 1998b).

6. Threats

Direct catch: According to Reyes (1991 and refs. therein), the species has been hunted in Japan, in particular in the East China Sea, although direct catches were not large and have not been reported since the mid-1980's. No direct catches of small cetaceans existed in China in 1994-95. Incidentally captured small cetaceans did not occupy an important place in the daily life of people in coastal China, and they were discarded in the sea or sold at a very low price in fish markets (Yang et al. 1999). According to Kasuya (1999) there is some controversy about the usefulness of this species for human consumption. People in Ayukawa on the Oshika Peninsula at the northern limit of this species, for instance, do not eat them, believing that they have a strong purgative effect, which was confirmed by a small experiment. However, the species is known to be sold for human consumption in Korea (IWC, 2000), although the source of these animals is unknown.

Incidental catch: Finless porpoises are accidentally caught in nets along the Indian and Pakistani coast, and off the Malay Peninsula although there is no estimate of the magnitude of these catches. Incidental catches are also reported from Japan, where porpoises get entangled in a variety of nets. Changes in fishing methods may have reduced the incidental catch in areas such as western Kyushu (Reyes, 1991 and refs. therein; Kasuya, 1999 and refs. therein). A total of 114 specimens were collected during 1985-1992 off the coasts of western and north-eastern Kyushu including part of the western Inland Sea of Japan: 84 of them were killed incidentally by fisheries, 25 were found dead on the beach or in the sea, and five were of unknown origin. Fisheries that killed the 84 porpoises were bottom gill net (58), surface gill net (17), trap net (7), trawl net (1) and drifting (ghost) net (1). The operation of such fishing gear is common in other parts of Japan and probably is killing finless porpoises off other coasts, although usually such catches remain unreported. Live captures have been reported from Ise Bay (Kasuya, 1999 and refs. therein).

Yang et al. (1999) surveyed incidental cetacean catches in coastal waters of China in 1994 – 1995. Finless porpoises were captured most frequently, totalling about 2,132 + 1484 individuals. Fishing gear employed was predominantly trawl-, gill-, and stow nets.

Habitat degradation: Finless porpoises are vulnerable to habitat encroachment, which is particularly true for the population in the Yangtse River, that may face the same threats as the *baiji* (see page 142). Increasing development requires construction of dams for hydroelectric power and diversion of water for agriculture. Dams may prevent movements of dolphins or reduce food availability (Reyes, 1991).

Pollution: Damage to the riverine ecosystem comes from the high level of pollution produced by several industries located along the Yangtse River. In coastal areas, increasing boat traffic and pollution may also affect this species. Finless porpoises disappeared from Ise Bay in Japan during a time of high pollution and returned when pollution was reduced. There has been some concern about the levels of pollution in the Inland

Sea of Japan, where the largest population may be present, at least seasonally (Reyes, 1991 and refs. therein).

Blubber samples of finless porpoises from the Inland Sea of Japan and Pacific area contained DDT isomers and metabolites at levels up to 10 times the concentration found in striped dolphins off the Pacific coast of Japan, and similar to those found in Baltic ringed seals with stenosis and uterus occlusion. Although such pathology has not been reported in the finless porpoise, pollution is very possibly a threat to the species (Kasuya, 1999 and refs. therein). Recently Le et al. (1999) reported concentrations of butyltin and Minh et al. (1999) of persistent organochlorines in finless porpoises. Parsons (1999) reports that mercury levels were high enough in some individuals as to pose a health risk and Parsons (1998a) noted that the number of reported small cetacean strandings in Hong Kong has increased dramatically in recent years: partially due to an increasing public awareness of local cetaceans and possibly due to escalating levels of human disturbance and anthropogenic pollution.

7. Remarks

The finless porpoise is protected directly or indirectly through national legislation in only a few countries in the range; these include Pakistan, Bangladesh, India, and Iran. In Japan it has been protected since 1930 in a 1.5 km radius around Awashima Island, where finless porpoises were used by fishermen as indicators of the presence of fish (Reyes, 1991 and refs. therein). The exact impact of incidental catches on small cetaceans in Chinese waters was not clear at present, but it has probably caused the decline of their populations (Yang et al. 1999).

The species is categorised as "Data Deficient" by the IUCN, but the population from the Yangtse and Chinese coastal waters is considered "Endangered (En C2b)" based on the fact that C) the population is estimated to number less than 250 mature individuals 2) a continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form that b) all individuals are in a single subpopulation. *N. phocaenoides* is listed in Appendices I & II of CITES.

Range States so far identified include Bangladesh, Burma, India, Indonesia, Iran, Iraq, Japan, Kampuchea, Kuwait, North Korea, Oman, Pakistan, People's Republic of China (including Taiwan), Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, United Arab Emirates, and Vietnam. Movements of the species across international boundaries are likely to occur, in particular in coastal areas at the mouth of major rivers such as the Ganges and Indus. The species is therefore listed in CMS Appendix II.

The species as a whole is in no immediate danger of extinction, but several populations (possibly representing separate taxa) are apparently declining. The IWC sub-committee discussed, in particular, the Inland Sea of Japan, where this species has declined in abundance in recent years (IWC, 2000). The causes of this decline are not fully understood. Incidental mortality in various kinds of fisheries is the only documented anthropogenic factor affecting the survival of finless porpoises. However, a number of anthropogenic influences such as chemical pollution, depletion of prey species, loss of habitat due to construction or extraction of sand, may all have contributed to the decline. Here, as elsewhere in the species' range, human populations adjacent to the finless porpoise's habitat are increasing in size and becoming more industrialised, so the expectation should be that anthropogenic pressures will continue and intensify:

The IWC sub-committee (2000) recommended:

- that molecular genetic and morphometric studies of finless porpoises be conducted to assist in clarifying taxonomy and stock structure in the genus *Neophocaena*. These studies should include analysis of existing specimens and new samples from areas that are currently underrepresented in collections,

- that a detailed assessment be conducted of variation in the density of finless porpoises in the Yangtse River system, to identify areas of high porpoise abundance, such as the Poyang Lake, that may deserve special protection,

- that the magnitude and effects of by-catches be investigated as a matter of priority,

- that further research be conducted to determine the causes of the population decline of this species in the Inland Sea of Japan and how to best stop or reverse this decline,

- that surveys be conducted throughout its known and suspected range, particularly in areas where little current information exists, for example along the coasts of the Indian Ocean.

In a recent workshop, Reeves et al. (2000) summarise that threats to finless porpoises in the Yangtse river include incidental mortality from entanglement in passive fishing gear, electric fishing, collisions with powered vessels, and exposure to explosives used for harbor construction. Much of their habitat has been severely degraded, due to the damming of Yangtse tributaries and the intensive use of the river as a transportation corridor. The effects of pollution and reduced availability of prey species are not well documented, but they represent serious additional concerns. The finless porpoise population in the Yangtse river is likely to continue declining unless serious efforts are made to protect the animals and their habitat. The ultimate goal of conservation efforts must be to maintain a viable wild population of porpoises in the river, and any ex-situ conservation strategy can only be justified if it contributes to that goal. Any proposal in this direction, in relation with the Shishou semi-natural reserve, should evaluate carefully the existing population on the site, that harmful fishing can be eliminated. A critical review of available information is needed on water and sediment quality. A programme of studying the animals presently in the reserve should be initiated. The need to educate people about and to strictly enforce regulations concerning the use of destructive fishing gear or methods is recognised.

For further recommendations, please see Perrin et al. (1996) in Appendix 2.

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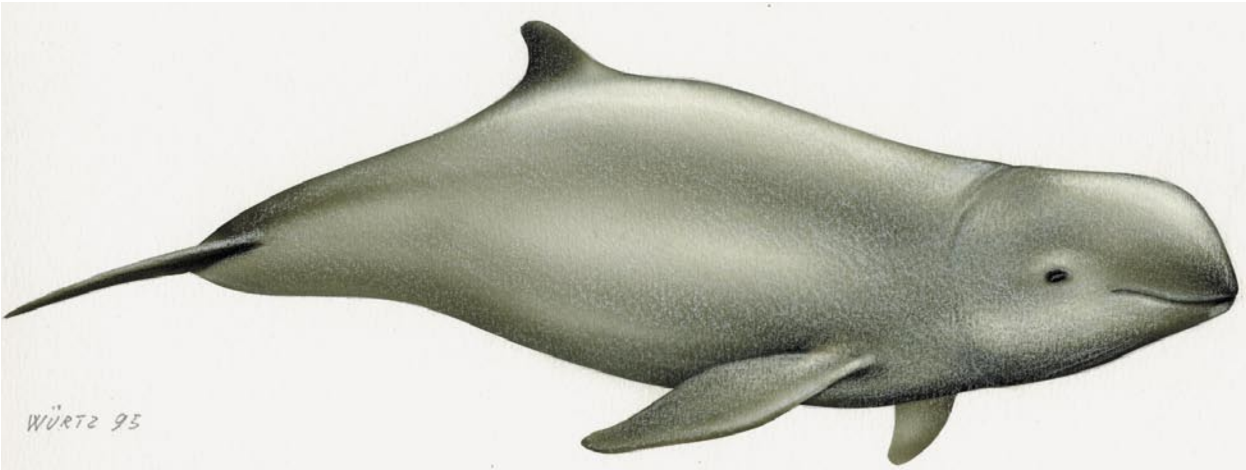
5.47 Orcaella brevirostris (Gray, 1866)

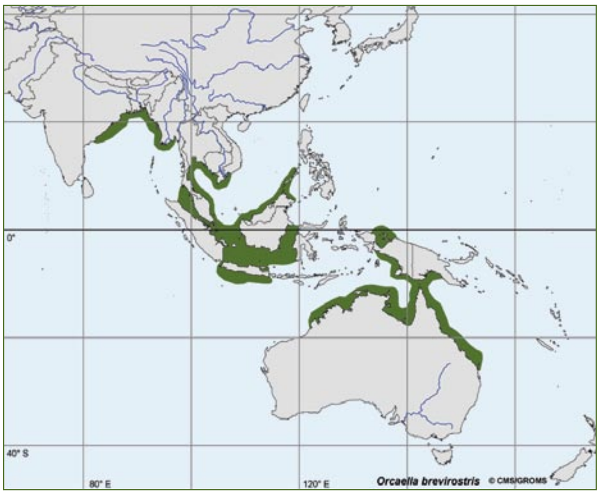
English: Irrawaddy dolphin
German: Irrawadi Delphin
Spanish: Delfín del Irrawaddy
French: Orcelle



Drawing of Orcaella brevirostris © Wurtz-Artescienza.

1. Description

The Irrawaddy dolphin resembles the beluga whale *Delphinapterus leucas* (see page 37) in general appearance and certain anatomical features. Recent morphological and genetic studies, however, consistently place it in the family delphinidae and its closest relative might be the killer whale *Orcinus orca* (see page 204) (Arnold, 2002). Rice (1998), points out that *O. brevirostris* shares more morphological similarities with the other Delphinidae than with the Monodontidae, based on morphological features, isozyme and immunological distance studies, by studies of satellite DNA, and by sequencing the cytochrome b gene.



Distribution of Orcaella brevirostris: warm coastal waters and rivers from the Bay of Bengal to Northern Australia (mod. from Arnold, 2002; © CMS/GROMS).

The mobile head of the Irrawaddy dolphin is broadly rounded and there is no sign of a beak. The dorsal fin is small, the flippers broad, paddle-like and highly mobile. The colour pattern varies regionally between dark grey to light grey, and in Australian animals, the belly is white and the flanks light grey to brown. Maximum recorded length is 275 cm, but on average only 210 cm, with a body mass of 115-130 kg (Arnold, 2002).

Several authors were unable to find differences between populations in the Irrawaddy, the Mekong, or marine waters (Marsh et al. 1989).

2. Distribution

Irrawaddy dolphins are discontinuously distributed mostly in the coastal, shallow, brackish, or fresh turbid waters at the mouths of rivers in south-eastern Asia and Australasia. Around the Asian mainland they range from Vishakhapatnam, Andhra Pradesh, India, around the Bay of Bengal to the Strait of Malacca and the Gulf of Thailand; there are freshwater populations in the distributaries at the mouths of the Ganges, in the Irrawaddy as far as 2,300 km upstream to Bhamo, and in the Mekong and Sekong River as well as in the Ayeyarwady River (Marsh et al. 1989; Jefferson et al. 1993; Rice, 1998; Baird and Mounsouphom,1997, Smith et al. 1997). The presence of the species has not been fully confirmed in China, but it is likely to occur there (Reyes, 1991 and refs. therein). According to Perrin (pers. comm.), the species has been reported from the Philippines.

The species occurs on the Sunda and Sahul shelves known from the Sungai Belawan Deli in northeastern Sumatra; Belitung; north coast of Jawa Timur (East Java); south coast of Jawa Tengah (Central Java); Kepulauan Bunguran (Natuna Islands); river mouths along the coast of Sarawak, Brunei, and Sabah; the Seruyan and Mahakam river systems, including Semayang, Melintang, and Jempang lakes, in Kalimantan Timur (East Kalimantan); Sungai Kumai in Kalimantan Tengah (Central Kalimantan); south-western Sulawesi; Teluk Cenderawasih (Geelvink Bay) in northwestern New Guinea; southern New Guinea from coast of Merauke east to the Gulf of Papua, thence south to northern Australia where it ranges from Point Cloates in Western Australia around to Gladstone in Queensland (Rice, 1998).

3. Population size

No statistically rigorous estimates of the abundance of this species are available from any portion of its range. The abundance of *Orcaella* is unknown or, at best, based on assessments made in small inshore or riverine areas. For coastal areas, very little information is available (IWC, 2000).

A survey undertaken in the late 1970s reported between 100 and 150 dolphins in Semayang Lake and the Pela River and adjacent Mahakam River in eastern Borneo. Formerly noted as extremely abundant, the population in Chilka Lake, India, was between 20-30 animals in the mid 1980's (Reyes, 1991, and refs. therein). However, the population was still under study in 1998 (Sahu et al. 1998).

Smith et al. (1997) report that they had only four cetacean sightings during 1,121 km of transect in the South China Sea and no sightings during 224 km of search effort in the Mekong River. The reason for the paucity of sightings, despite the variety of cetaceans documented from Vietnamese waters, is unknown, but these authors strongly recommend that research be conducted on levels of cetacean bycatch in fishing nets. According to Baird and Mousouhom (1994), anecdotal reports from villagers in Southern Laos and Cambodia imply that populations have greatly declined in recent years.

Freeland and Bayliss (1989) used standard aerial survey techniques to survey coastal waters adjacent to the Northern Territory, Australia. Relatively few Irrawaddy River Dolphins were observed in waters off the northwest coast. Substantial populations were located in the western Gulf of Carpentaria providing a total estimate of approximately 1,000 Irrawaddy River Dolphins on the surface. The major concentration was located in Blue Mud Bay. Although there were significant seasonal changes in distribution, Irrawaddy River Dolphins appeared to avoid waters less than 2.5 m, and greater than 18 m deep. The large Blue Mud Bay population is located adjacent to a major shrimp breeding area and is the largest population known.

Parra and Corkeron (in IWC, 2000) reported a feasibility study on the use of photo-identification techniques to study Irrawaddy dolphins in Cleveland and Bowling Green bays in Northern Queensland, Australia. From December 1998 to November 1999, 78 boat-based surveys were conducted, resulting in 46 sightings. Mean group size for these encounters was 5.6 and a total of 38 individual adult dolphins were identifiable.

4. Biology and Behaviour

Habitat: Irrawaddy dolphins seem to prefer coastal areas, particularly the muddy, brackish waters at river mouths and do not appear to venture far offshore, since all sightings have been made within only a few kilometres from the coastline. Some populations are apparently restricted to fresh water. In the Mekong River these dolphins are often observed near sand banks where streams flow into lakes (Reyes, 1991 and refs. therein). They have been seen in the same area as bottlenose and Indo-Pacific hump-backed dolphins. They are not particularly active, but do make low leaps on occasion. They are not known to bowride (Jefferson et al. 1993).

Schooling: Groups of fewer than 6 individuals are most common, but sometimes up to 15 dolphins are seen together (Marsh et al. 1989; Jefferson et al. 1993).

Food: Fish, cephalopods, and crustaceans are taken as food. Irrawaddy dolphins sometimes spit water while feeding, apparently to herd fish (Marsh et al. 1989; Reyes, 1991; Jefferson et al. 1993).

Reproduction: The calving season is not well known. Some calves appear to have been born from June to August, but 1 captive female gave birth in December (Jefferson et al. 1993). In the northern Hemisphere, mating is reported from December to June and gestation has been estimated at 14 months (Arnold, 2002).

5. Migration

In Semayang Lake, eastern Borneo, Irrawaddy dolphins perform daily migrations from the lake to the Mahakam River, returning to the lake in the evening. They may be found at distances up to 1,300 km upstream in major rivers, an indication of movements of considerable extent (Reyes, 1991).

Parra and Corkeron (in IWC, 2000) found that all animals identified during 1998 in Cleveland and Bowling Green bays in Northern Queensland, Australia, were resighted in 1999, suggesting some degree of residency. It was concluded that, for this area, photo-identification techniques could be used to study this species.

Kreb (in IWC, 2000) described her research on this species in the Mahakam River, and its associated lakes and in nearby coastal waters of East Kalirnantan, Indonesia. The middle section of the Mahakam River and tributaries between Mum Kainan (180 km from the mouth) and Melak (350 km from the mouth) was identified as primary dolphin habitat. The distribution changes seasonally and is influenced by water levels and perhaps variation in prey availability. Dolphins move into tributaries during high water and back into the main river when water levels recede. Most sightings were made at confluences and river bends.

6. Threats

Direct catch: Some small-scale hunting by local people probably occurs in many areas of the range (Jefferson et al. 1993). In some parts of Kampuchea and India, they are taken for food, but in most of the range they are protected by local beliefs. They are said to help fishermen by driving fish into the nets (Marsh et al. 1989; Reyes, 1991 and refs. therein).

Khmer and Vietnamese fishermen regard *Orcaella* as sacred animals, and release them if they become entangled in fishing nets. By contrast, Khmer-Islam fishermen kill them for food. The dolphins are reputed to have learnt to distinguish between the languages of these different communities, and are much more cautious about approaching the Khmer-Islam fishermen (Marsh, 1989 and refs. therein). Kreb and Beasley (in IWC, 2000) informed the IWC sub-committee that recent live captures have occurred for the oceanarium trade in the Mahakam River and coastal regions of Indo-Malaysia. In both these areas there are also reports of direct killing.

Incidental catch: Irrawaddy dolphins are accidentally caught in fishing nets in Bangladesh, India, and the Gulf of Papua and in anti-shark nets in Australia (IWC, 2000). In some areas animals are released, but in the case of drowned dolphins, the oil may be used for medicinal purposes. Because of their presence in coastal and riverine areas, incidental catches in fishing nets are likely to occur elsewhere in the range (Reyes, 1991; Jefferson et al. 1993). There have been no systematic observer schemes in freshwater or coastal regions, but evidence of bycatch and the increase in the use of gillnets are cause for concern. In addition, fishing with explosives may adversely affect this species in some areas (IWC, 2000).

Deliberate culls: None reported (Reyes, 1991).

Habitat degradation: Irrawaddy dolphins from Semayang Lake were formerly observed in the Makam River up to Tengagarong and Samararinda. Since the 1980's, probably due to the intense activity related to the timber industry, they are no longer observed near these towns but only above Muarakamen (Reyes, 1991 and refs. therein). Habitat degradation may limit the distribution and abundance of Irrawaddy dolphins, particularly in fresh water. Dams (Baird and Mounsouphom, 1997), gold mining using mercury abstraction techniques, increased sedimentation as a result of deforestation and other changes in river catchments, overfishing, harmful fishing techniques (poison and electrofishing), vessel traffic and noise pollution are all potential threats to this species. Coastal development with concomitant eutrophication is also cause for concern (IWC, 2000).

In Lao People's Democratic Republic, large hydro-electric dams planned for the Sekong River sub-basin and the mainstream of the Mekong River are a threat to the dolphins, fish populations, and local people. These projects should be reconsidered. Dolphin conservation strategies should involve local people in all parts of the planning and implementation process and should consider the entire river ecosystem rather than taking a single-species approach (Baird and Mounsouphom, 1997). Stacey and Leatherwood (1997) find that the apparent low abundance and recent declines in numbers of the Irrawaddy dolphin are cause for serious concern. Compared to many other cetaceans, there is relatively little known about this species. Habitat degradation is seen as the most important conservation concern, and incidental catch in fishing nets is also a growing problem.

Overfishing: Reduction of fish populations in Indonesian rivers by illegal fishing methods is a serious threat. A population inhabiting Chilka Lake in India is said to be declining because of reduction in food supply and silting of the lake due to agricultural development (Reyes, 1991 and refs. therein).

Pollution: Since Irrawaddy dolphins are found in rivers, they are likely to be affected by pollution and other habitat encroachment associated with the development of their tropical habitat (Reyes, 1991 and refs. therein).

7. Remarks

Like river dolphins and other species from tropical coastal regions, Irrawaddy dolphins are subject to increasing pressure from development. The species may be protected to some extent by local beliefs, but there are Incidental catches throughout the range. Overfishing may be reducing food supply, there are examples of restrictions in distribution, and in some areas direct captures take place. Moreover, since they are found far upstream in large rivers, construction of dams may have the same effect on these dolphins that is observed for the Ganges river dolphin (Reyes, 1991; Baird and Mounsouphom, 1994)

At the national level the species, together with all species of cetaceans, has been included in Schedule I of the Indian Wildlife Protection Act, which bans the sale of cetacean products. Semayang Lake in Indonesia has been proposed as a national park to protect this species. No other specific legislation relating to Irrawaddy dolphins is reported, although general provisions protect the species in Australia. In other countries, legislation for protection of habitat may be applicable (Reyes, 1991 and refs. therein).

Orcaella brevirostris is listed as "Data Deficient" by the IUCN and is included in Appendix II of CMS. Movements of Irrawaddy dolphins within estuaries of large rivers such as the Ganges and Brahmaputra, and in river systems flowing through more than one country, involve crossing national boundaries. Range States so far identified are Australia, Bangladesh, East Timor, India, Indonesia, Kanipuchea, Malaysia, Myanmar, Papua New Guinea, the Philippines, Thailand, and Vietnam (Reyes, 1991 and refs. therein).

Dhandapani (1997) summarises that as per the list of "IUCN Threatened Species Categories", *Orcaella brevirostris* Gray, 1966, falls under "Insufficiently known" species. Considering its localisation within restricted areas and habitats as a thin population over an extensive range, this species is recommended to be brought under the "Rare" category, particularly in the Indian subcontinent. As assessment of the present status of Irrawady River dolphin in Chilka lagoon, India, indicates that the deteriorating ecological condition, entangling in gill nets and drag nets, and wanton killing for oil have driven this localised population almost to the brink of extinction. In order to perpetuate this species in Chilka lagoon, it is emphasised that, in addition to regulating the operation of gill nets and drag nets to prevent accidental capture, breeding of a protected population in a constantly monitored seminatural impoundment set in its natural habitat is the only alternative to restore the population to its erstwhile status.

According to Hale (1997) the habitats of Irrawaddy dolphins in Australia include estuaries and near-shore coastal areas which are utilised for resource extraction and recreation and have been degraded in many areas as a result of urban, industrial and agricultural development. Conservation problems include incidental capture in nets, loss of prey from over-fishing and destruction of fish habitat, vessel disturbance, possibly pollution and maybe directed killing. Long-term conservation will require a mixture of regulation, education and community involvement. A focus solely on regulation through enforcement is likely to be of little benefit. Research into female survivorship and calving will assist efforts to assess population viability.

Priorities for conservation are studies of natural history and the effects of human activities on populations, especially in riverine habitats. Conservation programs should be launched in each Range State, and those sharing river systems should co-operate in reducing the effects of regional development on populations of this species (Reyes, 1991).

In its report on small cetaceans (IWC, 2000) the scientific IWC sub-committee recommended:

- that further investigations be carried out using morphometric and genetic techniques to better elucidate stock structure over the geographical range of Irrawaddy dolphins and to examine potential differences between freshwater and marine habitats,

- that comprehensive surveys be conducted to assess the abundance, distribution, and habitat quality of

Irrawaddy dolphins, with special emphasis on their fresh- and brackish-water range,

- that a review be carried out of the distribution and habitat preferences of the Irrawaddy dolphin in marine systems and to define oceanographic, bathymetric and biological features associated with high density areas,

- an immediate cessation of live captures until affected populations have been assessed using accepted scientific practices, given the likely precarious status of these animals throughout their range.

The sub-committee expressed concern about increases in fishing effort, particularly with gill nets, in some parts of the range of this species. Given the apparently small size of some populations, some by-catches in these fisheries may be unsustainable. The sub-committee recommended that appropriate by-catch mitigation strategies be developed for use with this species (IWC, 2000).

See also general recommendations on small cetaceans in Southeast Asia iterated in Perrin et al. (1996) and for isolated populations, recommendations issued for the baiji, (*Lipotes vexillifer*), page 142 and (Appendix 2), page 330, respectively.

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5.48 Orcinus orca (Linnaeus, 1758)

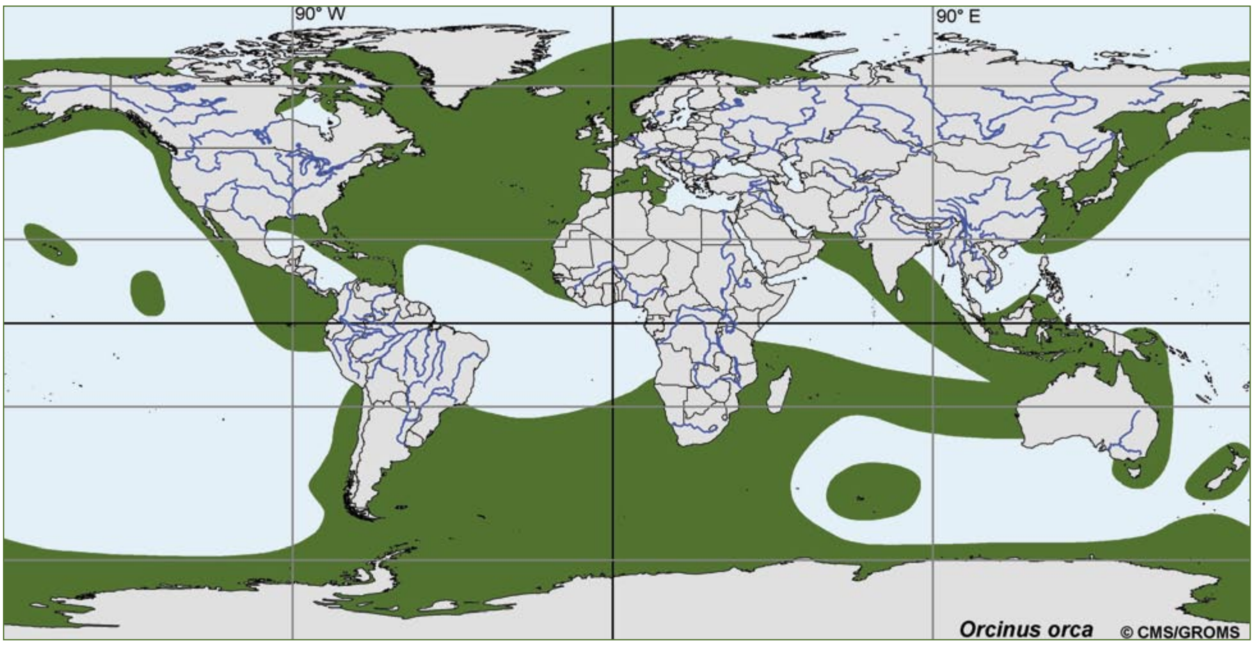
English: Killer whale
German: Schwertwal
Spanish: Orca
French: Orque

Drawing of Orcinus orca © Wurtz-Artescienza.

1. Description

Orcas are the largest member of the dolphin family. Maximum body lengths are 9 m in males and 7.7 m in females. Males reach 5,570 kg, whereas female maximum weight is 3,800 kg (Ford, 2002). Orcas are recognized by their distinctive black, white and grey coloration. A white eye patch, or spot, is located just above and behind the eye. Just behind the dorsal fin is a grey saddle patch. The whale's belly, lower jaw and the underside of the tail flukes are white. The rest of the body is black.

The wide, tall dorsal fin is curved backwards in females and triangle-shaped in males. The head is rounded, with no distinct beak. The pectoral flippers are paddle-shaped.



Distribution of Orcinus orca: this species is found in all regions of the world, particularly in the polar regions (map mod. from Dahlheim and Heining, 1999; © CMS/GROMS).

In addition to sexual size dimorphism, male appendages are disproportionately larger than in females.

Each pod of killer whales, or local group of pods, is largely endogamous and differs in minor ways from neighbouring groups in both morphology and genetics, as well as in traditions such as migratory behaviour, prey choice, and dialects (Rice, 1998 and refs. therein).

Studies in the eastern North Pacific, from Washington State to Alaska, have distinguished 2 types of killer whales, referred to as residents and transients. Although differentiated ecologically, there are also differences in coloration and external morphology. In Washington and British Columbia, residents are primarily fish eaters and transients eat mostly marine mammals. Some studies in other parts of the world suggest that this pattern may be universal (Jefferson et al. 1993).

Studies on mDNA restriction patterns provide evidence that the resident and transient pods are genetically distinct (Dahlheim and Heining, 1999 and refs. therein; Hoelzel et al. 1998). According to Black et al. (1997) and Ford (2002), however, there are at least three recognizable types of killer whales ("residents," "transients," and "offshores") in the eastern North Pacific that do not associate with members of the other groups. Each type exhibits different home ranges, vocalizations, dietary preferences, foraging patterns, morphological features, and genotypes.

A possible subspecies of "dwarf" or "yellow" killer whale, *Orcinus glacialis* was described from the ice edge in the Indian Ocean sector of the Antarctic from 60°E to 141°E. The skulls—especially the teeth—of the six specimens that were collected differ noticeably from those of most other killer whales. During the summer, at least, these small animals are said to range in the same waters as typical *0. orca* but not to mix in the same schools with the latter. The two kinds are also said to select different preyfish as opposed to mammals, respectively. However, further studies are needed to ascertain whether these small whales deserve recognition as a separate species or subspecies (Rice, 1998 and refs. therein).

2. Distribution

This is probably the most cosmopolitan of all cetaceans and can be seen in literally any marine region. *Orcinus orca* occurs throughout all oceans and contiguous seas, from equatorial regions to the polar pack-ice zones, and may even ascend rivers. However, it is most numerous in coastal waters and cooler regions where productivity is high (Jefferson et al. 1993; Dahlheim and Heining, 1999 and refs. therein).

In the Atlantic it ranges north to Hudson Strait, Lancaster Sound, Baffin Bay, Iceland, Svalbard, Zemlya Frantsa Iosifa, and Novaya Zemlya; its range includes the Mediterranean Sea. In the Pacific it ranges north to Ostrov Vrangelya, the Chukchi Sea, and the Beaufort Sea. In the Southern Ocean, the range extends south to the shores of Australia and the Philippines, South Africa, South America and Antarctica, including the Ross Sea at 78°S (Rice, 1998).

Data from the central Pacific are scarce. They have been reported off Hawaii, but do not appear to be abundant in these waters (Dahlheim and Heyning, 1999 and refs. therein).

3. Population size

Recent abundance estimates are available for various regions (Dahlheim and Heining, 1999 and refs. therein): In the north-eastern Pacific, photo-identification studies yielded at least 850 individuals in Alaska, 117 off the Queen Charlotte Islands, 260 "resident" whales and 75 "transient" whales off eastern and southern Vancouver Island, 184 off the coast of California, and 65 off the Mexican west coast. Note that photo-identification techniques result in a minimum count of animals. In a more recent estimate, Ford (2002) comes to a total population count of 1,500 orcas in the north-eastern Pacific.

In the North Atlantic, questionnaire surveys yielded 483-1,507 killer whales for Norwegian coastal waters (Dahlheim and Heining, 1999 and refs. therein). Sightings in the eastern North Atlantic gave rough estimates of around 3,100 killer whales for the area comprising the Norwegian and Barents Seas, as well as Norwegian coastal waters and some 6,600 whales for Icelandic and Faroese waters (Reyes, 1991 and refs. therein).

Off the Japanese coast the estimate is 1,200 individuals north of 35°N and 700 south of 35°N (Dahlheim and Heining, 1999 and refs. therein). For Antarctica, the most recent estimate is 80,400 killer whales south of the Antarctic convergence (Kasamatsu and Joyce, 1995).

For the Southern Indian Ocean, Poncelet et al. (2002) report a strong decline of *O. orca* in the coastal waters of Possession Island between 1988 and 2000.

4. Biology and Behaviour

Habitat: Sightings range from the surf zone to the open sea, though usually within 800 km of the shoreline. Large concentrations are sometimes found over the continental shelf. Generally, orcas prefer deep water but they can also be found in shallow bays, inland seas, and estuaries (but rarely in rivers). They readily enter areas of floe ice in search of prey (Carwardine, 1995). Resident killer whales in Pacific Northwest waters use regions of high relief topography along salmon migration routes, whereas transient whales forage for pinnipeds in shallow protected waters (Dahlheim and Heining, 1999 and refs. therein).

Reproduction: In the Pacific Northwest, calving occurs in non-summer months, from October to March. Similarly, in the Northeast Atlantic, it occurs from late autumn to mid-winter (Jefferson et al. 1993).

Schooling: Pods of resident killer whales in British Columbia and Washington represent one of the most stable societies known among non-human mammals; individuals stay in their natal pod throughout life. Differences in dialects among sympatric groups appear to help maintain pod discreteness. Most pods contain 1 up to 55 whales and resident pods tend to be larger than those of transients (Jefferson et al. 1993). Social organization can be classified into communities, pods, subpods, and matrilineal groups: a community is composed of individuals that share a common range and are associated with one another; a pod is a group of individuals within a community that travel together the majority of time; a subpod is a group of individuals that temporarily fragments from its pod to travel separately; and a matrilineal group consists of individuals within a subpod that travel in very close proximity. Matrilineal groups are the basic unit of social organization, and consist of whales from 2-3 generations. Membership at each group level is typically stable for resident whales, except for births and deaths (Dahlheim and Heining, 1999 and refs. therein).

Being a top predator, the killer whale utilizes the available resources in a complex fashion. Killer whales often associate with other marine mammals (cetaceans and pinnipeds) without attacking them (Dahlheim and Heining, 1999 and refs. therein). Baird and Dill (1996) summarize that the typical size of transient killer whale groups is consistent with the maximisation of energy intake hypothesis. Larger groups may form for the occasional hunting of prey other than harbour seals, for which the optimal foraging group size is probably larger than three; and the protection of calves and other social functions.

Food: Killer whales are best known for their habits of preying on warm-blooded animals: they have been observed attacking marine mammals of all groups, from sea otters to blue whales, except river dolphins and manatees. However, they often eat various species of fish and cephalopods and occasionally seabirds and marine turtles (Jefferson al. 1993; Ford et al. 1998; Saulitis et al. 2000). Pods often co-operate during a hunt. Relationship with the prey is complex: pods tend to specialise and may frequently ignore potential prey (Carwardine, 1995).

Domenici et al. (2000) observed killer whales feeding on herring (*Clupea harengus*) in a fjord in northern Norway using underwater video. The whales co-operatively herded herring into tight schools close to the surface. During herding and feeding, killer whales swam around and under a school of herring, periodically lunging at it and stunning the herring by slapping them with the underside of their flukes while completely submerged.

While herring constitute the whales' main diet in Norwegian waters, cod, flatfish, and cephalopods are the primary components off Japan. In Puget Sound, off the North American west-coast the main food of resident killer whales during the summer and fall is salmon. Most food items are swallowed whole. However, when whales attack larger prey, they rip away smaller pieces of flesh and then consume them. The tongues, lips, and genital regions of baleen whales seem to be the favoured parts (Dahlheim and Heining, 1999 and refs. therein).

Killer whales consume fish of commercial importance. Troll catches of salmon show a decline when killer whales are in the area and damage to fishing gear has also been reported. Off Iceland, killer whales are attracted to herring operations. Longline fisheries interactions involving killer whales have also been observed (e.g. Secchi et al. 1998). Killer whales are known to follow fish-processing vessels for many miles feeding off discarded fish. In the Bering Sea, the same pod of whales was reported to follow a vessel for 31 days for approximately 1,600 km (Dahlheim and Heining, 1999 and refs. therein).

5. Migration

Based on photo-identification studies, numerous individual whales and/or pods have been documented to move between Puget Sound (Washington)/British Columbia and south-eastern Alaska; between south-eastern Alaska and Prince William Sound; and between Prince William Sound and Kodiak Island. On an international level, whale movements from Alaska (USA) and British Columbia (Canada) to California (USA) and from California to Mexico have been documented. In most geographical regions, killer whale movements may be related to movements of their prey. Orcas may travel 125–200 km per day while foraging (Dahlheim and Heining, 1999 and refs. therein; Guerrero-Ruiz et al. 1998).

In the Beaufort, Chukchi and northern Bering Seas, orcas move south with the advancing pack ice, performing long-range movements. Similar movements are reported for the western North Atlantic. Killer whales approach the Chukotka coasts in June and leave the area in November or even as late as December. On the other hand, year-round and seasonal occurrences are recorded for the waterways of British Columbia and Washington State, where pods are known to range approximately 370 nautical miles. Norwegian data indicate that killer whales occur in coastal waters all year-round, with concentrations in the Lofoten, More and Finnmark areas. However, orcas present in offshore Norwegian waters appear to arrive there from Icelandic waters, following the migration of herring (Reyes, 1991 and refs. therein).

Similae and Christensen (1992) photoidentified killer whales around the Lofoten and Vesteralen islands northern Norway during fall-winter (October-February) and summer (June-August) in 1990 and 1991. Based on a capture- recapture estimate, they determined that about 500 killer whales are present in these overwintering areas of the herring. Most of the whales leave the study area in January when herring migrate to the spawning grounds 700 km farther south. Based on the seasonal distribution, killer whale groups can be divided into three different types; whales present in fall-winter (25 groups), whales present both in fall and summer (12 groups) and whales present in summer (six groups).

Similae et al. (2002) satellite tagged Orca off Norway. Most of the positions were received from the wintering grounds of herring. However, five of the tagged whales made long distance movements away from this area; the swimming and diving behaviour of the whales as well as information on prey items suggests that the function of these trips was to survey areas where herring is abundant during other seasons than winter. Based on photoidentification data collected since 1987 the range of killer whales during October-January had been estimated to be 13,583 km^2 (estimated as a minimum convex polygon). The satellite tracking study expanded the known range of killer whales during this season considerably. Ranges varied between individuals; the smallest estimated Kernel home range was 3,566 km^2 (95 % isopleth) and the largest 288,284 km^2 (95 % isopleth; Similae et al. 2002).

In Northern Patagonia the seasonal distribution of killer whales is correlated to the distribution of South American sea lions and southern elephant seal. Most encounters with the whales at Punta Norte occurred in December and March-May, during the sea lions breeding cycle. Whales depart the area in May when pinnipeds migrate to winter rookeries. One pod, Patagonia Norte B (PNB) was photographed in Golfo San José on 9 January 1986 and in Punta Norte 1 day later, some 60 km apart (Iniguez, 2001).

Evidence of seasonality is also observed in the southern part of the north-eastern Atlantic. In the southern hemisphere, killer whales are found in warm waters in winter and migrate into high latitudes in the summer. This migration appears to be related to the migration of prey species, in particular the minke whale (Reyes, 1991 and refs. therein). However, Gill and Thiele (1997) report sighting killer whales in Antarctic sea ice in August, i.e. in late winter, indicating that some individuals may be resident year-round.

Transient whales appear to cover a more extensive range than residents. A distance of over 2,600 km (California to Alaska) has been reported for a transient group: Forney and Barlow (1998) photographed three individuals in Monterey Bay, California, that had previously been identified off Alaska.

6. Threats

Direct catch: Killer whales have been exploited at low levels in several regions world-wide (Jefferson et al. 1993). Norwegian whalers in the eastern North Atlantic took an average of 56 whales per year from 1938 to 1981. The Japanese took an average of 43 whales per year along their coastal waters from 1946 to 1981. The

Soviets, whaling primarily in the Antarctic, took an average of 26 animals annually from 1935 to 1979, but took 916 animals in the 1979/80 Antarctic season (Dahlheim and Heining, 1999 and refs. therein; Reyes, 1991).

After 1976, Iceland has been involved in live-captures of killer whales for export. During the period 1976–1988, 59 whales were collected, of which 8 were released, 3 died and 48 (an average 3.7 per year) were exported (Reyes, 1991 and ref. therein). In 1991, the Icelandic government announced that after expiry of permits for live capture, no new ones would be issued (Jefferson et al. 1993). Live-captures of killer whales have also taken place in Japanese waters (Reyes, 1991 and ref. therein).

Incidental catch: Incidental takes during fishing operations occur, but are considered rare (Dahlheim and Heining, 1999 and refs. therein).

Culling: Fishermen in many areas see killer whales as competitors, and shooting of whales is known to occur. This problem was especially serious in Alaska, where conflicts with longline fisheries occur (Jefferson et al. 1993). Although much reduced, some such persecution continues today (Ford, 2002).

Pollution: High levels of PCBs and DDT (250 ppm and 640 ppm, respectively) were reported in the blubber of an adult male transient killer whale in Washington State and 38 ppm PCB and 59 ppm DDE wet weight levels in a resident male (Dahlheim and Heining, 1999 and refs. therein). Ross et al. (2000) report that total PCB concentrations were surprisingly high in three killer whales communities (2 resident and 1 transient population) frequenting the coastal waters of British Columbia, Canada. Transient killer whales were particularly contaminated. Toxic Equivalents in most killer whales sampled easily surpassed adverse effects levels established for harbour seals, suggesting that the majority of free-ranging killer whales in this region are at risk from toxic effects. The southern resident and transient killer whales of British Columbia can be considered among the most contaminated cetaceans in the world (Ross et al. 2000).

Habitat degradation: Habitat disturbance may be a matter for concern in areas inhabited by killer whales and supporting whale-watching industries (Reyes, 1991). Visser (1999) e.g. reports on propeller scars observed on orcas and their possible causes of mortality.

Moving boats can also interfere with natural activities and resting, and underwater boat noise can affect social and echolocation signals of the whales or otherwise interfere with foraging. These effects are likely to be cumulative and may result in displacement or reduced fitness and death (Ford, 2002). From a sound propagation and impact model Erbe (2002) deduced that fast boats are audible to killer whales over 16 km, mask killer whale calls over 14 km, elicit a behavioral response over 200 m, and cause a temporary threshold shift (TTS) in hearing of 5 dB after 30-50 min within 450 m. For boats cruising at slow speeds, the predicted ranges were 1 km for audibility and masking, 50 m for behavioral responses, and 20 m for TTS. Superposed noise levels of a number of boats circulating around or following the whales were close to the critical level assumed to cause a permanent hearing loss over prolonged exposure. From a study on the effects of acoustic harassment devices, Morton and Symonds (2002) deduce that whale displacement resulted from the deliberate introduction of noise into their environment.

Williams et al. (2002) investigated whether the current guidelines for whalewatchers are sufficient to minimise disturbance to northern resident killer whales in Johnstone Strait, British Columbia, Canada. Local guidelines request that boaters approach whales no closer than 100 m. Additionally, boaters are requested not to speed up when close to whales in order to place their boat in a whale's predicted path: a practice known as "leapfrogging". Williams et al. (2002) find that leapfrogging is a disruptive style of whalewatching, and should be discouraged: as the experimental boat increased speed to overtake the whale's path, the source level of engine noise increased by 14-dB. Assuming a standard spherical transmission loss model, the fast-moving boat would need to be 500 m from the whale for the received sound level to be the same as that received from a slow-moving boat at 100 m. Whale-watching guidelines should therefore encourage boaters to slow down around whales, and not to resume full speed while whales are within 500 m.

The Exxon Valdez oil spill in Alaska was strongly correlated with the subsequent loss of 14 whales from a pod that had been seen swimming through light oil slicks early in the spill (Ford, 2002). Oil spills may also have an indirect effect by reducing prey abundance (Ford, 2002).

Overfishing: Although in general opportunistic feeders, some populations of killer whales could be affected by reduction of their food supply. For example, coastal Norwegian populations reportedly feed mainly upon herring, a fish heavily exploited in the area (Reyes, 1991 and refs. therein). In Alaska, anthropogenic effects on the ecosystem have been made responsible for orca predation on sea-otters and associated ecological implications (Estes et al. 1998). In British Columbia, Canada, and Washington State, US, salmon stocks have significantly declined as an effect of overfishing, habitat degradation and reduced ocean survival. This is likely to affect fish-eating resident orca populations in that area (Ford, 2002).

Other factors: For the Southern Indian Ocean, the strong decline reported by Poncelet et al. (2002) for the coastal waters of Possession Island between 1988 and 2000 may be attributed to several factors: i) a low and decreasing fecundity, possibly impacted by a density dependence (Allee effect); ii) the decline of the main preys: large baleen whales due to past whaling, and southern elephant seals (*Mirounga leonina*) from the 1970 to 1990 which remained in low numbers up to 1997 at least ; iii) the possible mortality induced by recent interactions with the Patagonian toothfish (*Dissostichus eleginoides*) longline fishery; and iv) the possible dispersion of individuals or groups from the coastal waters. A few individuals were observed with poorly known "offshore" killer whales interacting with longliners, but presently, there is no evidence of mixing with surrounding killer whale concentrations in Prince Edward Islands, south Africa or Antarctic. A preliminary toxicological study indicates that PCB levels are considerably lower than in British Columbia transients, however the burdens are not negligible (Ross, pers. com.) and the effects of PCBs on health at the observed concentrations are unknown. Poncetel et al. (2002) fear that the killer whales of Possession Island might disappear with unique genetic diversity and social culture, like AT1 transients in Alaska.

7. Remarks

Orcinus orca is categorised as "Lower risk, conservation dependent" by the IUCN.

Although considered resident in the area, killer whales from Washington State undertake seasonal movements in pursuit of their preferred prey, the salmon. These migrations lead the animals to cross the national boundaries of Canada and the United States. Similar movements occur in the eastern North Atlantic, where orca are said to migrate between Icelandic and Norwegian waters following the herring that constitutes their main prey. Therefore, the eastern North Atlantic as well as the eastern North Pacific populations are included in Appendix II of CMS. The proposal to list all populations of the Killer whale in Appendix II was endorsed in 2002 by the Working Group of the CMS in Bonn as all the populations were migratory and could profit from cooperative protective measures.

Further studies on population structure, abundance and life history are needed for most populations worldwide. For South American stocks, see comments and recommendations in the Hucke-Gaete (2000) report in Appendix 1. See also general recommendations on Southeast Asian stocks in Perrin et al. (1996) in Appendix 2.

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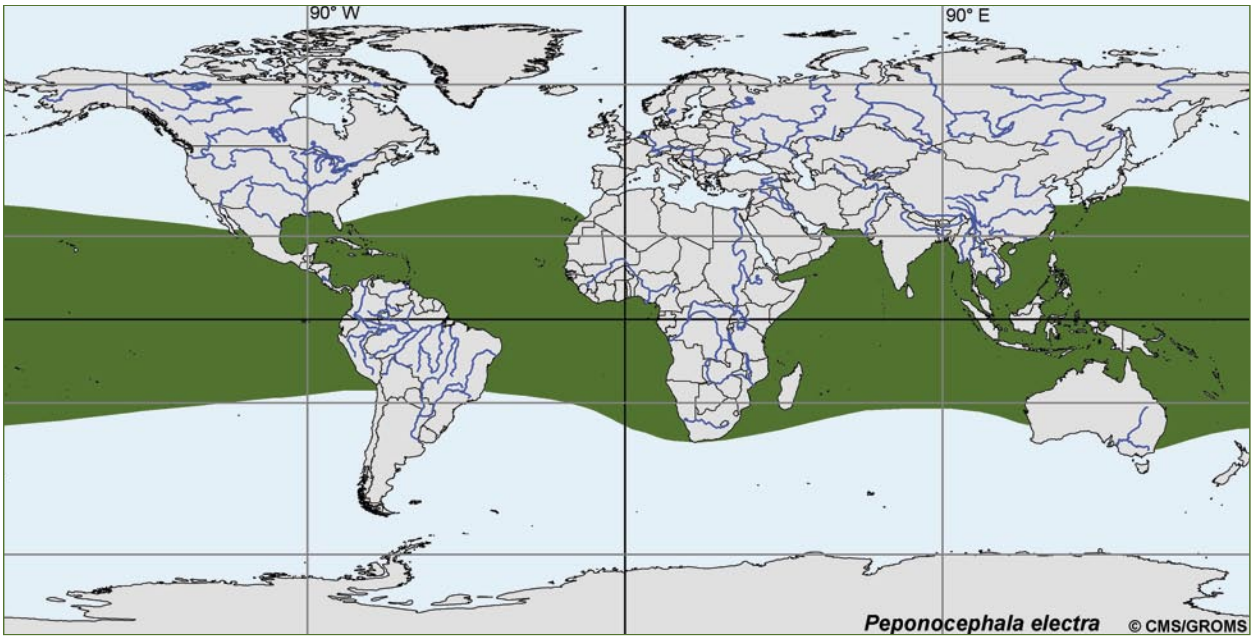
5.49 Peponocephala electra (Gray, 1846)

English: Melon-headed whale
German: Breitschnabeldelphin
Spanish: Calderón pequeño
French: Péponocéphale

Drawing of Peponocephala electra © Wurtz-Artescienza.

1. Description

P. electra is mostly dark grey, with a faint darker grey cape, which narrows at the head. A faint light band extends from the blowhole to the apex of the melon. A distinct dark eye patch, broadening as it extends from the eye to the melon, is often present. The lips are often white, and white or light grey areas are common in the throat region and the venter. At sea, the melon-headed whale is difficult to distinguish from the pigmy killer whale (*Feresa attenuata*) (see page 64), but *P. electra* has a more pointed head and sharply pointed pectoral fins. Males grow larger than females (252 and 143 cm, respectively) and may attain up to 228 kg (Perryman, 2002).



Distribution of Peponocephala electra: tropical and subtropiocal offshore waters around the world (mod. from Jefferson et al. 1993; W.F. Perrin, pers. comm.; © CMS/GROMS).

2. Distribution

Melon-headed whales are pantropical. They range north to the Gulf of Mexico, Senegal, Arabian Sea, Bay of Bengal, South China Sea, Taiwan, southern Honshu, Hawaiian Islands, and Baja California Sur; and south to Espiritu Santo in Brazil, Timor Sea, northern New South Wales, and Peru (Rice, 1998). Mignucci et al. (1998) report the species from the Caribbean sea.

Specimens from southern Japan, Cornwall in England, Cape Province in South Africa, and Maryland, USA probably represent the extremes of the normal distribution for this species and may have come from populations in adjacent warm currents (Perryman et al. 1994; Rice, 1998).

3. Population size

One of the few population estimates based on survey data is of 45,000 individuals for the eastern tropical Pacific. They are reported to be abundant in Philippine Seas, especially near Cebu Island, and are frequently seen in waters around the Hawaiian Islands, in the Tuamotus-Marquesas Islands, along the east coast of Australia, and in the oceanic, equatorial Pacific. The lack of reports on this species from many other areas may reflect a preference for offshore habitats where survey effort is generally lowest (Perryman et al. 1994 and refs. therein). Recently, Dolar (1999) estimated a population size of 1,200 for the eastern Sulu Sea.

4. Biology and Behaviour

Habitat: Most sightings are from the continental shelf seaward, and around oceanic islands. Rarely found in temperate waters (Carwardine, 1995). In the eastern tropical Pacific, the distribution of reported sightings suggests that the oceanic habitat of this species is primarily in the upwelling modified and equatorial waters (Perryman et al. 1994).

Behaviour: The animals make low, shallow leaps out of the water when travelling fast, often creating a lot of spray as they surface and making it difficult to see any detail. Slow swimmers may lift their head right out of water on surfacing. They are usually wary of boats, but many observations are in areas where tuna boats regularly chase dolphins, so their behaviour may differ elsewhere. They are known to bow-ride for short periods and breaching has occasionally been recorded. Sometimes they spyhop (Carwardine, 1995; Perryman et al. 1994).

Schooling: Melon-headed whales are highly social and more likely to be seen in large pods than the Pygmy Killer Whale. They occur usually in pods of 100 to 500 (with a known maximum of 2,000 individuals). Animals in a pod are often tightly packed and make frequent course changes. *P. electra* may associate with Fraser's Dolphins, and sometimes other cetaceans such as spinner dolphins and spotted dolphins (Carwardine, 1995; Jefferson et al. 1993).

Mass strandings of melon-headed whales have been reported from Moreton Island and Crowdy Heads, Australia, Malekoula Island, Vanuatu, the Seychelles, Aoshima, Japan, Piracanga Beach, Brazil, the Kwajalein Atoll, and Tambor, Costa Rica. It has been noted that in several mass strandings of this species, the ratio of females to males was about 2:1. This may reflect behavioural segregation (Perryman et al. 1994 and refs. therein).

Reproduction: There is some evidence to indicate a calving peak in July and August, but this is inconclusive (Jefferson et al. 1993). In the southern hemisphere, calving may peak between August and December (Klima, 1994).

Food: Melon-headed whales are known to feed on squid and small fish (Jefferson et al. 1993; Perryman et al. 1994; Clarke and Young, 1998).

5. Migration

No migrations are known (Carwardine, 1995), although the fact that the species follows warm currents may lead it through coastal waters of a variety of countries.

6. Threats

Direct catch: This species is taken occasionally in the subsistence fishery for small cetaceans near the island of St Vincent in the Caribbean and in the Japanese dolphin drive fishery. They continue to be taken in a long-lived and well-established harpoon fishery for sperm whales and various small cetaceans near Lamalera, Indonesia. Four melon-headed whales were taken during the 1982 fishing season. Small-boat fisherman also occasionally harpoon or net this species near Sri Lanka and in the Philippines (Jefferson et al. 1993; Perryman et al. 1994). Dolar et al. (1994) investigated the fisheries for marine mammals in central and southern Visayas, northern Mindanao and Palawan, Philippines. Hunters at several sites took melon-headed whales for bait or human consumption. Whales are taken by hand harpoons or, increasingly, by togglehead harpoon shafts shot from modified, rubber-powered spear guns. Around 800 cetaceans of various species are taken annually by hunters at the seven sites, mostly during the inter-monsoon period of February–May.

Incidental catch: Mortalities from incidental captures in the purse-seine fishery for yellowfin tuna in the eastern Pacific will probably continue at a very low level (Perryman et al. 1994).

7. Remarks

This is a poorly known oceanic species which probably follows oceanographic features such as currents and upwellings near coasts. This behaviour might bring it into coastal waters of a variety of range states in tropical and subtropical waters. Data on abundance, behaviour at sea and by-catch rates is very sparse. For South American stocks, see further comments and recommendations in Hucke-Gaete (2000) in Appendix 1, and regarding Southeast Asian populations, please see Perrin et al. (1996) in Appendix 2.

Not listed by IUCN or CMS.

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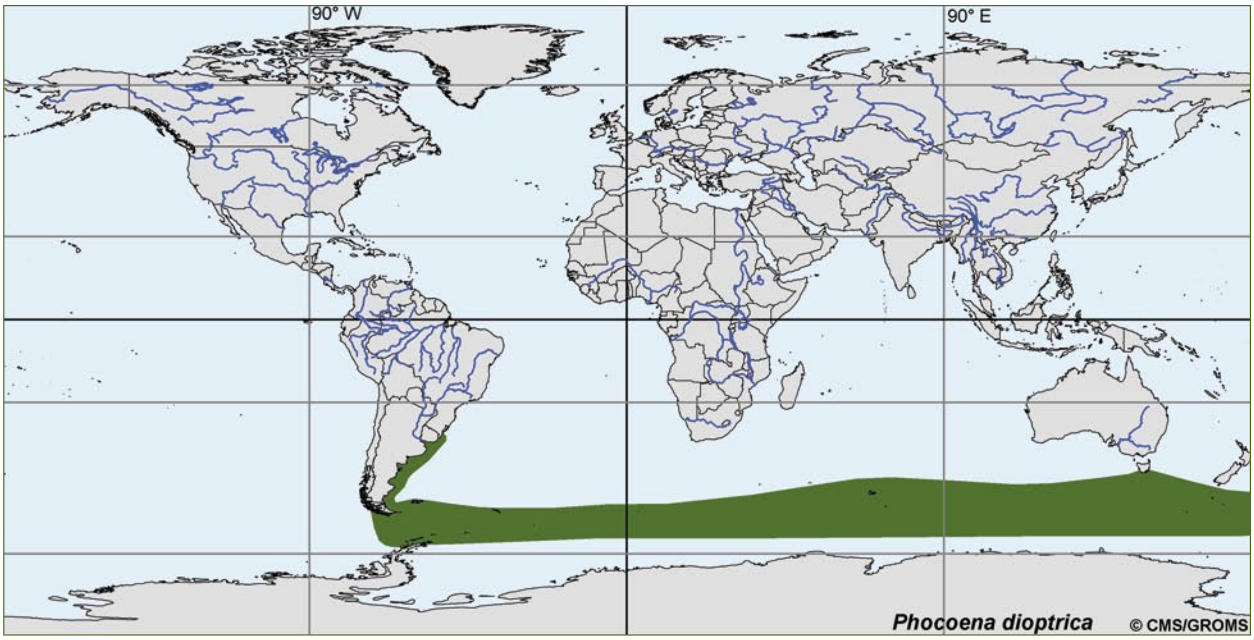
5.50 Phocoena dioptrica (Lahille, 1912)

English: Spectacled porpoise
German: Brillenschweinswal
Spanish: Marsopa de anteojos
French: Marsouin à lunettes

Drawing of Phocoena dioptrica © Wurtz-Artescienza.

1. Description

The spectacled porpoise is highly distinctive with its unusual pigmentation, small head and facial features and the large male dorsal fin. It is a robust animal with a rounded head and beak. The flippers are small and situated well forward. The dorsal fin is broadly triangular and grows much larger and rounded in males than in females. The flukes are small and have rounded tips. Adults are black dorsally, sharply separated from the white belly. Size ranges to 204 cm in females and 224 cm in males and mass to 85 kg in females and 115 kg in males (Goodall, 2002). The Spectacled Porpoise is poorly known. Until the mid-1970s, only 10 specimens had been discovered. Since then, intensive searches have revealed more than 100 others, mostly from strandings along beaches of Tierra del Fuego, in southern South America; most reports are of animals that were already dead on discovery and often in an advanced state of decomposition (Carwardine, 1995).



Distribution of Phocoena dioptrica: coastal waters of southeastern South America and offshore islands around Antarctica (mod. from Goodall, 2002; © CMS/GROMS).

2. Distribution

Distribution of this species is puzzling because there are records from widely separate locations; some of these may involve strays, or cases of mistaken identity. Records from offshore islands (mostly of dead animals and skulls), hint at a circumpolar distribution and suggest that the range may also include large areas of open sea. It is not known whether these represent isolated populations, or whether they mix with mainland coastal animals by migrating across the open sea (Carwardine, 1995). Sightings have occurred in offshore waters, as well as in rivers and channels (Jefferson et al. 1993).

According to Goodall (2002), *Phocoena dioptrica* is circumpolar in cool temperate, sub-Antarctic and low Antarctic waters. It ranges in coastal waters of south-eastern South America, from Santa Catarina in Brazil (32°S) south to Tierra del Fuego; Falkland Islands (Islas Malvinas); South Georgia; Iles Kerguélen; Heard Island; Tasmania; Macquarie Island; Auckland Islands; Antipodes Islands (Rice, 1998). Kemper and Hill (2001) also report first records of the spectacled porpoise in continental Australian waters. The documented range further extends from temperate latitudes south into the sub- or low Antarctic, including areas just south of the Antarctic Convergence (Brownell and Clapham, 1999).

3. Population size

Nothing is known on the abundance of this porpoise. It was the most commonly encountered species during preliminary beach surveys undertaken on Tierra del Fuego by R. N. P. Goodall, but once the beaches had been cleared it was exceeded in frequency of occurrence by Commerson's dolphin (Brownell and Clapham, 1999).

4. Biology and Behaviour

Habitat: Spectacled porpoises seem to occur only in cold temperate waters. Although they have been observed or incidentally caught in coastal waters, their habitat is thought to be primarily oceanic in nature. Where recorded, water temperatures associated with sightings ranged from 5.5°C to 9.5°C (Brownell and Clapham, 1999).

Behaviour: These animals are very inconspicuous when surfacing (Jefferson et al. 1993).

Schooling: *P. dioptrica* appears to live mainly alone (most of the strandings and sightings are of solitary animals), but may also live in small groups (Carwardine, 1995; Jefferson et al. 1993).

Reproduction: Births appear to occur in the southern spring to summer (Jefferson et al. 1993). Nothing is known on pregnancy rates, interbirth intervals or duration of lactation in this species (Brownell and Clapham, 1999).

Food: Based upon its dentition, it is likely that, like other phocoenids, this species feeds upon fish and squid. The sole record of prey remains are of anchovy (*Engraulis* sp.) and small crustaceans (possibly stomatopods) found in the stomach of a 6 year old male stranded in Chubut, Argentina (Brownell and Clapham, 1999, and refs. therein).

5. Migration

Nothing is known on the seasonal movements, if any, of this species (Brownell and Clapham, 1999).

6. Threats

Direct catch: In the past, spectacled porpoises were killed deliberately for food. In Argentina and Chile, spectacled porpoises are taken in gillnets, and they may be taken deliberately for crab bait off southern Chile. The effects of these catches on spectacled porpoise populations are not known (Jefferson et al. 1993).

Incidental catch: At least 34 animals were killed incidentally between 1975 and 1990 in coastal gill nets set in Tierra del Fuego, and there was a co-occurrence of strandings and fishing activity in south-eastern Chile, suggesting additional undocumented mortalities from this source. Some mortality of spectacled porpoises was also reported from bottom and mid-water trawls off the coast of Chubut, Argentina (Brownell and Clapham, 1999, and refs. therein). Jefferson and Curry (1994) summarise that the effects of incidental takes on the population are unknown.

7. Remarks

According to Jefferson and Curry (1994), gillnets represent the single most important threat to porpoises as a group, and this may be an example of a "no technical solution problem". They conclude that better documentation of catches and new approaches to dealing with porpoise/gillnet interaction problems are needed in order to prevent the loss of several species and populations. See further recommendations and conclusions on South American stocks in Hucke-Gaete (2000) in Appendix 1.

IUCN Status: "Data Defficient". *Phocoena dioptrica* is included in Appendix II of CMS.

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5.51 Phocoena phocoena (Linnaeus, 1758)

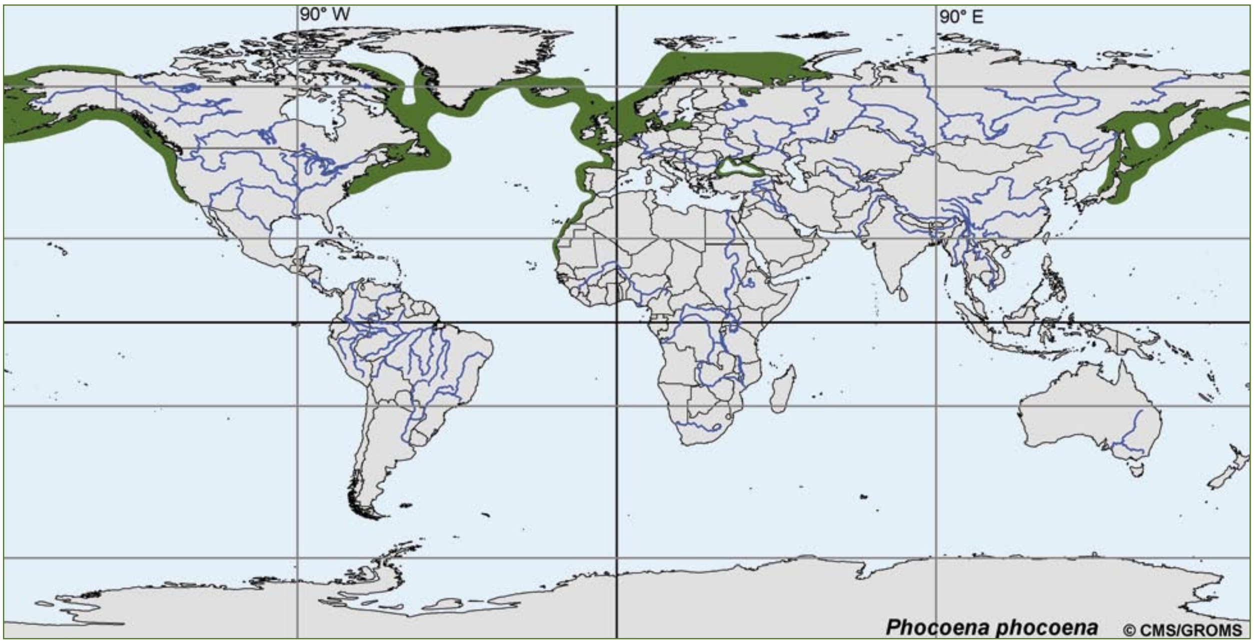
English: Harbour porpoise
German: Schweinswal
Spanish: Marsopa común
French: Marsouin commun

Drawing of *Phocoena phocoena* © Wurtz-Artescienza.

1. Description

Harbour porpoises have a short, stocky body resulting in a rotund shape, which enables them to limit heat loss in cold northern climes. Adult females reach a mean size of 160 cm, males only 145 cm in length and mean body mass is 60 kg and 50 kg, respectively. The dorsal side is dark grey, while the belly is a contrasting white which sweeps up to the midflanks in a mottled pattern. There is a dark stripe from the mouth to the flippers.

The small triangular dorsal fin and the characteristic swimming pattern of several short, rapid surfacings followed by an extended dive of several minutes are characteristic for this species. Whereas early morphological studies suggested a close relationship of the harbour porpoise with *P. sinus* and *P. spinipinnis*, recent genetic information suggests that the closest relative of the harbour porpoise is in fact *Phocoenoides dalli* (Bjorge and Tolley, 2002).



Distribution of the four subspecies of Phocoena phocoena: cold temperate and subarctic waters of the Northern Hemisphere (mod. from Bjorge and Tolley, 2002; © CMS/GROMS).

2. Distribution

Harbour porpoises are found in cool temperate and subpolar waters of the Northern Hemisphere (Jefferson et al. 1993). Significant differences in the skulls of *P. phocoena* from the North Atlantic, the western North Pacific, and the eastern North Pacific have been found and two subspecies are recognised, one in the Atlantic and one in the Pacific. However, western Pacific animals differ sufficiently from those in the eastern Pacific to warrant subspecific separation, although no species-group name has been based on a western Pacific specimen (Rice, 1998 and refs. therein).

P. p. phocoena is distributed in the North Atlantic Ocean and ranges on the western side from Cumberland Sound on the east coast of Baffin Island, south-east along the eastern coast of Labrador to Newfoundland and the Gulf of St. Lawrence, thence south-west to about 34°N on the coast of North Carolina; it is also found in southern Greenland, north to Upernavik on the west coast and Angmagssalik on the east coast. In the eastern Atlantic, its range includes the coasts around Iceland; the Faroes; and the coasts of Europe from Mys Kanin and the White Sea in northern Russia, west and south as far as Cabo de Espichel, Portugal (38°24'N), including parts of the Baltic Sea and the British Isles. An apparently isolated population ranges along the coast of West Africa from Agadir (30°30'N), Morocco, south to Dakar (14°38'N), Senegal; its members appear to attain a greater body length than European individuals. (Rice, 1998 and refs. therein). In the Gulf of Bothnia and the Gulf of Finland, both in the Baltic Sea, the species is no longer observed (Koschinski, 2002).

Four discrete populations are believed to exist in the western North Atlantic: Bay of Fundy-Gulf of Maine, Gulf of St. Lawrence, Newfoundland and Labrador, and Greenland. The population structure of harbour porpoises in the north-eastern Atlantic and North Pacific is complex and not well understood (Read, 1999, and refs. therein).

Rosel et al. (1999) pooled and reanalysed three datasets comprised of mitochondrial DNA control region sequences, representing the Northeast and Northwest Atlantic regions to examine the degree of trans-Atlantic exchange among harbour porpoise populations. They conclude that movements of harbour porpoises across the Atlantic appear to occur at a low level. A disjunction in haplotypic frequencies between the Northeast and Northwest Atlantic probably occurs east of Greenland, indicating a population barrier in these waters.

In a recent genetic study, Andersen et al. (2001) found that harbour porpoises from West Greenland, the Norwegian Westcoast, Ireland, the British North Sea, the Danish North Sea and the inland waters of Denmark (IDW) are all genetically distinguishable from each other.

A number of studies found differences between Baltic Sea and North Sea animals, although comparison of studies is difficult because sampling areas and methods differed notably. The limits of a putative Baltic subpopulation and the amount of genetic exchange between regions has yet to be resolved (Koschinski, 2002).

P. p. phocoena is vagrant along the arctic coast east to Novaya Zemlya and Mys Bolvanskiy; absent from the Mediterranean, except for former, or sporadic, occurrences in the western part (Strait of Gibraltar, Islas Baleares, Barcelona, and Tunisia; Rice, 1998).

P. p. subsp. occurs in the Western North Pacific Ocean. It ranges from Olyutorskiy Zaliv south along the east coast of Kamchatka, including Komandorskiye Ostrova and the Near Islands in the western Aleutian Islands, throughout the Ostrova Kuril'skiye, and all around the shores of the Sea of Okhotsk, including Zaliv Shelikhova, Hokkaido, and Honshu as far as Nishiyama on the west coast and Taiji on the east. A distributional gap in the Aleutian Islands between Shemya and Unimak separates this race from the next. *P. p. subsp*. is vagrant north through Bering Strait as far as Ostrov Vrangelya (Rice, 1998).

P.-p.-vomerina Gill, 1865 is distributed in the Eastern North Pacific Ocean and ranges from the Pribilof Islands, Unimak Island, and the south-eastern shore of Bristol Bay south to San Luis Obispo Bay, California. *P.-p.-vomerina* is vagrant north to Point Barrow in Alaska, and the mouth of the Mackenzie River in the Northwest Territories of Canada, and south to San Pedro in Southern California. (Rice, 1998).

P. p. relicta is another geographically disjunct population which inhabits the Black Sea, the Sea of Azov, the Bosporus, and the Sea of Marmara, with at least one individual reported in the northern Aegean Sea (Rice, 1998). According to Read (1999), recent analyses of geographic variation in mitochondrial DNA (mtDNA) support the existence of this subspecies.

3. Population size

Recent abundance estimates have been summarised by Read (1999; see refs. therein). In the Eastern Pacific Ocean: Central California 4,120; Northern California 9,250; Oregon and Washington 26,175. In the Atlantic Ocean: Gulf of Maine 67,500; Skaggerak and Belt Seas 36,046; North Sea 279,367; Ireland and western UK 36,280. In a recent paper, Hammond et al. (2001; 2002) estimate the harbour porpoise population in the North Sea at 350,000 individuals, based on an extensive line-transect survey conducted in 1994.

Abundance estimates are lacking for large parts of the range of the species, particularly the western Pacific and the Black Sea.

Harbour porpoises were once numerous in the Baltic Sea but today the population is estimated at only some hundreds of animals. From acoustic and visual surveys conducted between 8 June and 11 August 2002 from the research vessel "Song of the Whale" porpoises were found to be widely distributed throughout the Kiel and Mecklenburg Bights; however, the relative abundance of porpoises was considerably lower in Baltic waters. Only three porpoises were detected in the Baltic block. Acoustic detection rates varied greatly, from 16.2 detections/100-km in the northern Kiel Bight, 9.2/100 km in the southern Kiel Bight, and 2.8/100 km in the Mecklenburg Bight to only 0.1/100 km in the Baltic proper. During visual surveys porpoises were only sighted in Kiel Bight. The results are consistent with a survey of Polish coastal waters conducted in 2001 using the same equipment, which found 0.05 detections/100 km (Gillespie et al. 2003). Kilian et al. (2003) support these findings using autonomous click detectors (PODs): The first results of the POD data collected in the Baltic Sea reveal strong variations among the chosen areas. Around the island of Fehmarn, harbour porpoise click trains were recorded almost every day, whereas along the east coast of the island of Rügen, only few porpoise encounters were collected. Nevertheless, for most areas investigated, porpoises were present regularly.

These results support those of previous surveys, indicating that porpoises are now extremely rare in the Baltic. The current bycatch, amounting to at least seven porpoises per year, is unsustainable and Baltic porpoises may become extinct in the near future unless action is taken to prevent future anthropogenic mortalities (Gillespie et al. 2003).

As opposed to this, Scheidat et al. (2003) report that on the Oderbank east of Rügen, Baltic harbour porpoise concentrations between May and August 2002 were very high with 0.086 animals per km aerial transect, as opposed to 0.014 and 0.024 in nearby Mecklenburg and Kiel Bights, respectively. The reason for this high density in the area of the Oderbank seems to be reproductive behaviour.

Note that all abundance estimates have to be taken with a grain of salt: According to Read (1999) there was an 80 % discrepancy between abundance estimates made for the Gulf of Maine in 1991 and 1992; both surveys covered the known range of this population, but produced dramatically different estimates of abundance in different years (37,500 as opposed to 67,500, respectively). The factors responsible for this inter-annual variation may be related to migratory behaviour in response to a variation in water temperature on a regional scale, but are not fully understood.

Similarly, Carretta et al. (2001) estimated the abundance of harbor porpoises in northern California at 5,686 from a November 1995 ship survey. However, this abundance estimate was significantly different from an aerial survey estimate obtained 1 to 2 months earlier in the same region, where abundance was estimated at 13,145. Possible explanations for differences in estimates include seasonal movement of porpoises to other areas or depths, insufficient transect effort during the ship survey, or underestimates of the fraction of porpoise groups missed on the trackline due to large swells.

4. Biology and Behaviour

Habitat: Throughout its range, *P. phocoena* is limited to the waters of the continental shelf by its demersal foraging behaviour and diving capacity (see below). Harbour porpoises are seldom found in waters with an annual average temperature above 17°C. In some areas, especially on the East coast of Scotland, agonistic interactions with bottlenose dolphins (*Tursiops* sp.) may play a role in determining the limits of the range. Analyses of distribution over several spatial scales indicate that porpoises are found most frequently in cool waters, where aggregations of prey are concentrated (Read, 1999 and refs. therein). Carretta et al. (2001) found that porpoise distribution in northern California is not random with respect to water depth; significantly more porpoises than expected occurred at depths of 20 to 60 m and fewer porpoises than expected occurred at depths >60-m. They frequent relatively shallow bays, estuaries, and tidal channels under about 200 m in depth and will swim a considerable distance up-river (Carwardine, 1995).

Behaviour: The harbour porpoise is difficult to observe. It shows little of itself at the surface, so a brief glimpse is the most common sighting. On calm days it may be possible to approach a basking animal, but it is generally wary of boats and rarely bow-rides. It can sometimes be detected by the blow which, although rarely seen, makes a sharp, puffing sound rather like a sneeze (Carwardine, 1995). Observations from cliffs above calm fjords yield the best results (Culik et al. 2001).

Schooling: Most harbour porpoise groups are small, consisting of fewer than 8 individuals (pers. obs.). They do, at times, aggregate into large, loose groups of 50 to several hundred animals, mostly for feeding or migration (Jefferson et al. 1993). Harbour porpoises are not generally found in close association with other species of cetaceans (Read, 1999).

Reproduction: Most calves are born from spring through mid-summer (Jefferson et al. 1993). The majority of female harbour porpoises in Denmark and the Bay of Fundy become pregnant each year and are simultaneously lactating and pregnant for much of their adult lives. In contrast, female porpoises in California do not appear to reproduce each year (Read, 1999 and refs. therein).

Food: Harbour porpoises eat a wide variety of fish and cephalopods, and the main prey items appear to vary on regional and seasonal scales (Jefferson et al. 1993). In the North Atlantic, harbour porpoises feed primarily on clupeoids and gadoids, while in the North Pacific they prey largely on engraulids and scorpaenids. Squids and benthic invertebrates have also been recorded, the latter considered as secondarily introduced (Reyes, 1991 and refs. therein). Individual prey are generally less than 40 cm in length and typically range from 10 cm to 30 cm in length (Read, 1999). Dives to at least 220 m have been recorded via telemetry (Bjorge and Tolley, 2002).

Fontaine et al. (2003) analysed trace elements concentrations (Zn, Cu, Cd, Se, total Hg) and stable isotopes of carbon (d13C) and nitrogen (d15N) in 23 harbour porpoises caught in fishing nets along the Norwegian coast. The low isotopic composition suggests that Norwegian porpoises feed on more oceanic prey as confirmed by variations of hepatic Hg and renal Cd concentrations. Given that teutophagous marine mammals present higher concentrations of Cd than piscivorous ones, their results lead to the conclusion that the Norwegian porpoises rely on more oceanic squids than those from the North Sea.

5. Migration

Some seasonal movements (related to food availability) occur: mostly inshore in summer and offshore in winter, but sometimes north in summer and south in winter. In some areas, populations are present year-round (Carwardine, 1995). Webster et al. (1995) analysed stranding data from the North Carolina coast and found that harbour porpoises typically strand during the winter and spring months during migrations.

In the western North Atlantic, harbour porpoises arrive in the Bay of Fundy area in July, staying there until approximately late September. There is little evidence that the region may be significant either as a mating area or a calving ground. The arrival of females with calves coinciding with the arrival of juvenile herring is more suggestive of a feeding ground (Reyes, 1991 and refs. therein). Trippel et al. (1999) noted in a by-catch study in the lower Bay of Fundy that during years of low herring abundance, low harbour porpoise entanglement rates are observed. This suggests harbour porpoise movements matched the migratory behaviour of one of their preferred prey species.

According to Read (1999) porpoises in each of the Bay of Fundy—Gulf of Maine, Gulf of St. Lawrence, Newfoundland and Labrador, and Greenland populations move into coastal waters during summer. In some areas, harbour porpoises move offshore to avoid advancing ice cover during winter.

Observations gathered from surveys off New Hampshire suggest this may be part of the wintering areas for the Bay of Fundy population, which may have a north-south (and inshore-offshore) seasonal migration limited to the continental shelf in the eastern seaboard (Reyes, 1991 and refs. therein). In general, however, our understanding of the winter distribution of porpoises is limited by a lack of survey data (Read, 1999).

With the exception of limited observations of naturally marked individuals, all information on harbour porpoise movements has come from telemetry studies (Read, 1999). Early VHF telemetry studies in the Bay of Fundy suggested that porpoises exhibit limited ranges during the summer months. These studies were plagued by short periods of radio contact with tagged porpoises, which limited the inferences that could be drawn from the movement data (Read, 1999 and refs. therein). More recent long-term studies using satellite-linked radio telemetry (Read and Westgate, 1997) indicate that porpoises are extremely mobile and are capable of covering large distances in relatively short periods. The mean daily distance travelled by eight porpoises equipped with satellite-linked transmitters in the Bay of Fundy, for example, varied between 14 km and 58 km. Tagged individuals made rapid point-to-point excursions lasting from hours to days that were interspersed with longer periods of residency in restricted areas. These animals moved throughout the Bay of Fundy and Gulf of Maine, utilising home ranges that encompassed tens of thousands of km^2 (Read and Westgate, 1997). Porpoises exhibited a high degree of individual variation in movement patterns; five moved out of the Bay of Fundy into the Gulf of Maine. The porpoise with the longest tracking period moved extensively throughout the Gulf of Maine. These data suggest that seasonal movement patterns of individual harbour porpoises are discrete and are not temporally co-ordinated migrations. Porpoises that moved out of the Bay of Fundy into the Gulf of Maine did so following the 92 m isobath, which may represent an important movement corridor. The movement of porpoises from the Bay of Fundy into the Gulf of Maine supports the hypothesis that harbour porpoises from these two regions comprise a single population at risk of entanglement in both Canadian and US fisheries (Read and Westgate, 1997).

Seasonal migration between Danish waters and the Baltic Sea virtually ceased during the period 1940–1950. Formerly in early spring, the animals were seen migrating through Danish waters, where harbour porpoises are still common most of the year. In November, December and part of January, a migration out of the Baltic took place. At present the number of harbour porpoises migrating through Danish waters is lower than before. The causes of these changes are yet unknown, but they could be related to overhunting until the 1950's.

Teilmann et al. (2003) used satellite transmitters on 20 animals in Skagerrak/North Sea and 33 in Inner Danish Waters. The animals were tracked for up to 355 days. Throughout the year there was no overlap in the home range of adult porpoises tagged in the two areas, respectively. The authors suggest a population boundary in the northern Kattegat across the Danish island of Læsø. This population structure is confirmed by genetic studies of all ages during the summer season. In a few cases subadult porpoises tagged in the Inner Danish Waters moved into the Skaggerak/North Sea while only one of the tagged porpoises moved into the Baltic proper for a short visit. Seasonal migration between Inner Danish Waters and the North Sea was observed in one case when a subadult female tagged in the fall spent the winter along the North Sea coast of Jutland and returned to the exact same area where it was tagged six months earlier. In the North Sea the porpoises preferred the Skaggerak and northeastern North Sea along the deep trench along Norway. However, all of the northern North Sea between UK, Shetland Islands, Denmark and Norway was exploited.

The balance of opinion points to the North Sea as the wintering area for the majority of animals from inner Danish waters, although it is possible that Norwegian waters are also used (Reyes, 1991, and refs. therein). Koschinski (2002) recently summarised that 1) there might be a tendency of animals from the Kattegat to migrate into the North Sea during winter months; 2) a proportion of animals may stay in the western Baltic during the winter or even in the Baltic Proper; 3) there might be a difference in migratory tendency between putative subpopulations; and finally 4) migration patterns might depend on winter severity.

The latter point is supported by Forney (1999), who investigated trends in the abundance of harbour porpoises in central and northern California for the period 1986-95. Porpoise sighting rates were analysed in relation to area, sea state, cloud cover, year and sea surface temperature anomaly (SSTa). The result indicates a significant, non-linear effect of sea surface temperature on porpoise sighting rates, with no significant year effect once SSTa is included. These results suggest that harbour porpoises may exhibit interannual movement in and out of the study area in relation to changing oceanographic conditions.

According to Gaskin et al. (1993) seasonal harbour porpoise migrations, especially in and out of the Sea of Okhotsk, must occur because of extensive ice coverage in winter, but in Japanese waters there are confirmed records of porpoises as far north as the northern tip of Hokkaido Island in January.

The Black Sea population is relatively Isolated with no evidence of Interaction with Atlantic populations. According to an account from the 1930's, harbour porpoises arrived along the Crimean coast of the Black Sea in large numbers in October-November, when the Black Sea sprat began to migrate; the same situation was observed in March-April when the Azov sprat began to migrate. However, there are no recent accounts of movements of the species in this area (Reyes, 1991, and refs. therein).

6. Threats

Direct catch: Directed fisheries have occurred in Puget Sound, the Bay of Fundy, Gulf of St. Lawrence, Labrador, Newfoundland, Greenland, Iceland, Black Sea, and the Baltic Sea. Many of these fisheries are now closed, but hunting of harbour porpoises still occurs in a few areas. Greenland and the Black Sea are the only areas where large direct catches have been reported recently (Jefferson et al. 1993). According to Reyes (1991) around 1,000 porpoises are taken annually in West Greenland using rifles and hand-thrown harpoons. While catches off Greenland do not seem to pose a threat to local populations, those in the Black Sea and the Sea of Azow do (Koschinski, pers. comm.). Hunting on a small scale also still occurs in Japan, Canada and the Faroe Islands.

Incidental catch: Due to their habitat in productive coastal waters, harbour porpoises are captured incidentally in commercial fisheries throughout their range. Porpoises are taken in a variety of gear types including weirs, pound nets, cod traps and surface gill nets, but the vast majority of this mortality occurs in bottom-set gill nets. Particularly large by-catches have occurred in gill net fisheries (in the early 1990's) in the Bay of Fundy (100-424-p.a.) and Gulf of Maine (1,200-2,900-p.a.), the Gulf of St.-Lawrence, Newfoundland, western Greenland (134-1,531-p.a.), Iceland and the North (4,629-p.a.) and Celtic Seas (2,049 p.a.). Smaller by-catches occur in many other areas, e.g. California (44-92 p.a.) and may have significant effects on local populations. In the past, and in some areas still today, fishermen and their families used the meat of harbour porpoises to supplement their diet (Read, 1999).

Kuklik and Skóra (2003) report that in Polish waters of the Baltic Sea, by-catch occurs mostly in salmon driftnet and cod bottom-set nets, amounting to 62 by-catch reports between 1990 and 1999. Berggren et al. (2002) estimated potential limits to anthropogenic mortality for harbour porpoises in the Baltic region and concluded that immediate management action is necessary to reduce the magnitude of by-catches to meet the conservation objectives of ASCOBANS, the Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas.

In northern Portuguese waters (Ferreira et al. 2003) a total of 77 cetacean strandings were recorded between 2000 and 2002, involving 7 different species. The common dolphin was the species most commonly recorded with 60% (n = 46) of all strandings reported, followed by the harbour porpoise with 19% (n = 15). Confirmed bycatch was responsible for 34% of all strandings and up to 18% of the deaths were suspected to have been caused by interactions with artisanal fishing gear. Earlier observations have shown that this coastal area is used by harbour porpoises as an important feeding and breeding site, thus making bycatch a serious threat to the species. Preliminary results seems to indicate that beach purse seines may play an important role on the overall mortality of harbour porpoises. In fact, up to 53% of all harbour porpoise strandings recorded involved animals caught in this type of fishing net. Common dolphins and harbour porpoises may also be accidentally caught in gill nets set close to the coast.

Pollution: Pollution is a matter of concern throughout the range of the species, especially in the North and Baltic Seas. Analysis of pollutants revealed high concentrations in porpoises from those areas, but the effects on the populations have not yet been tested adequately. However, similar levels are known to cause reproductive problems in other mammals. The large rivers of the Canadian province of New Brunswick empty into the waters of the Bay of Fundy, transporting, among other pollutants, DDT heavily used in the past in the forests. The absence of dolphins and porpoises from the Azov Sea may be the result of the high levels of contamination of these waters. The main sources of pollution in the Black Sea are the industrial wastes carried by several rivers that drain into the Sea, domestic effluents and pesticides (Reyes, 1991 and refs. therein).

A considerable body of literature exists describing the levels of various pollutants in tissues of the harbour porpoise. Contaminant levels in harbour porpoises often vary geographically and may serve as useful markers in studies of population structure (Read, 1999 and ref. therein, Koschinski, 2002).

Vetter et al. (1996) determined organochlorine levels (PCBs, SIGMA-DDT, lindane and its isomers, HCB, chlordane, and toxaphene) in blubber samples of harbour porpoises. Varying ratios of contaminants in individual harbour porpoises were explained by migration.

Fontaine et al. (2003) found that hepatic concentrations of Zn, Cu and total Hg in Norwegian porpoises were among the lowest in the North-Atlantic and makes this population suitable to be used as a reference level for future ecotoxicological studies on this species.

Overfishing: Large scale fisheries operating in the North Sea take large catches of fish, most of which are important prey items for harbour porpoises. A similar situation occurs with the commercial fisheries for horse mackerel and anchovy in the Black Sea (Reyes, 1991 and refs. therein)

Habitat degradation: Harbour porpoises react very sensitively to anthropogenic noise. Consequently, shipping, marine exploration, construction and operation of noisy equipment are likely to affect the behaviour and distribution of the species.

7. Remarks

There have been several reports of decline of harbour porpoise populations in various parts of the range. The population of the Mediterranean is nearly extinct, and the low abundance of porpoises observed around Japan may be the result of overhunting or incidental catches in the past. The same is true for the Baltic Sea. In the North Atlantic, the major problem is the high incidental catch in relation to estimated population. The status of the Black Sea population is at present unknown, although the species is considered as severely depleted in the area (Reyes, 1991 and refs. therein).

The causes of lowered abundance may be diverse, but they are primarily related to human activities. Overhunting played a major role in the Black Sea, while in the North Sea by-catch, pollution, overfishing, traffic and offshore industries, either as single factors or a combination of them, may be responsible for the decline of the species in the area. Unfortunately, not enough is known on the population dynamics of the species to allow evaluation of the effects of these factors (Reyes, 1991 and refs. therein).

In its recent review of the status of this species in the North Atlantic, the Scientific Committee of the International Whaling Commission (1996, in Read, 1999) noted that, in the areas where adequate data on abundance and by-catch levels exist, incidental mortality exceeds sustainable levels. The Committee "perceives a broad-scale risk to harbour porpoise populations in the North Atlantic due to problems related to fishery by-catch". The World Conservation Union IUCN (http://www.iucn.org) has also recognised this threat, listing the species as vulnerable throughout its range. There is some hope that acoustic deterrents may help to reduce by-catch rates in gill nets in certain fisheries, provided foraging harbour porpoises can find prey in net-free areas (Culik et al. 2001). These devices are now mandatory in Danish gillnet-fisheries around wrecks (Finn Larsen, pers. comm.). Another solution may lie in using enticing sounds, i.e. of alerting porpoises to nets rather than attempting to deter them. Koschinski et al. (2003) and Eskesen et al. (2003) report that certain sounds trigger investigative behaviour, echolocation activity increasing by 70–130 % to investigate the sound source. This may help in alerting them to otherwise "invisible" nets.

National legislation gives complete protection to the species, with the exception of Greenland and Japan. However, incidental catches still represent a serious threat in many areas, mostly because of the difficulty of reducing their occurrence. Information on biology, population dynamics and by-catches is urgently needed for most of the populations and subpopulations (Reyes, 1991).

Phocoena phocoena is categorised as "vulnerable" (Vu A1cd) by the IUCN, based on the fact that A) there is a population reduction in the form of 1) An observed, estimated, inferred or suspected reduction of at least 80 % over the last 10 years or three generations, whichever is the longer, based on (and specifying) c) a decline in area of occupancy, extent of occurrence and/ or quality of habitat and d) actual or potential levels of exploitation. Furthermore, the Baltic and Black sea populations are classified as "vulnerable" (Vu C1+2b) which means that these populations are estimated to number less than 250 mature individuals and 1) an estimated continuing decline of at least 25 % within three years or one generation, whichever is longer or 2) a continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form b) all individuals are in a single subpopulation.

As a result of increasing concern about their current status, populations of harbour porpoises from the North and Baltic seas are listed in Appendix II of CMS. Other populations listed in CMS Appendix II are those of the western North Atlantic: Canada, France (St.-Pierre-et-Miquelon), Greenland and the United States. These are seriously threatened by the gillnet fishery in the Bay of Fundy / Gulf of Maine area, as well as directed catches off Greenland. The Black Sea / Sea of Azov population (Bulgaria, Romania, Turkey and the USSR) is also listed by CMS and was previously depleted by overhunting and may now be facing a reduction of its food supply.

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5.52 Phocoena sinus (Norris & McFarland, 1958)

English: Vaquita
German: Hafenschweinswal
Spanish: Vaquita
French: Marsouin du Golfe de Californie

Drawing of *Phocoena sinus* © Wurtz-Artescienza.

1. Description

The vaquita is the smallest of the porpoises. Mean length for females is 140 cm. The flippers are proportionately larger than in other phocoenids and the fin is taller and more falcate. The pigmentation is a dark grey cape, pale lateral field and white ventral field. There are large black eye rings and lip patches. The skull is smaller and the rostrum is shorter and broader than in other members of the genus. The vaquita is one of the most endangered cetacean species in the world (Rochas-Bracho and Jaramillo-Legoretta, 2002).

Distribution of Phocoena sinus: murky coastal waters in the northern quarter of the Gulf of California. This is the most restricted range of any marine cetacean (mod. from Rochas-Bracho and Jaramillo-Legoretta, 2002; © CMS/GROMS).

2. Distribution

The vaquita is endemic to the head of the Golfo de California, from Puertecitos, Baja California Norte, north and east to Puerto Peflasco, Sonora. (Reports from farther south have never been confirmed; Rice, 1998). It is most commonly found around the Colorado River delta (Carwardine, 1995).

The distribution in the upper Gulf of California appears to be highly localised, with the highest densities offshore of San Felipe and Rocas Consag, and offshore of El Golfo de Santa Clara (Vidal et al. 1999).

3. Population size

Only few serious attempts have been made to estimate the total size of the vaquita population. In 1986, an approximate lower limit of 50–100 individuals was estimated for the population, which was too low: a minimum of 143 vaquitas were killed in various fishing operations between March 1985 and January 1994 with an annual incidental mortality of 35. Recently, line-transect surveys yielded an estimate of 503 from boat surveys (1986-1993), 885 from aerial surveys (1986-1989), 572 from an aerial survey (1991), and 224 from a ship survey (1993). All of these abundance figures indicate that the species is at a critically low level (Vidal et al. 1999). Jaramillo-Legorreta et al. (1999) conducted a line-transect survey specifically designed to estimate vaquita abundance over its entire range in the summer of 1997. Results confirmed that the range of the vaquita is restricted to the north-western corner of the Gulf of California, but that the boundaries of the Upper Gulf of California and Colorado River Delta Biosphere Reserve do not correspond well with the distribution of vaquitas. The shallow water north of the town of San Felipe was found to have a higher density of animals than had been indicated by previous surveys. The total population size was estimated to be 567 animals.

4. Biology and Behaviour

Habitat: The vaquita lives in shallow, murky lagoons along the shoreline and is rarely seen in water much deeper than 30-m; indeed, it can survive in lagoons so shallow that its back protrudes above the surface (Carwardine, 1995). Other characteristics of its habitat are strong tidal mixing, convection processes and high primary and secondary productivity (Rochas-Bracho and Jaramillo-Legoretta, 2002). Silber (1990) reported 51 sightings in water depths of 13.5–37 m, and most of these sightings were 11–25 km from shore. Water visibility ranged from 0.9 m to 12 m.

Behaviour: There are very few records of the Vaquita in the wild. It appears to swim and feed in a leisurely manner, but is elusive and will avoid boats of any kind. It rises to breathe with a slow, forward-rolling movement that barely disturbs the surface of the water, and then disappears quickly, often for a long time. It has an indistinct blow, but makes a loud, sharp, puffing sound reminiscent of the harbour porpoise (Carwardine, 1995).

Schooling: Like other phocoenids, *P. sinus* occurs singly or in small groups. In 58 sightings, 91 % comprised from one to three individuals, with a mean group size of 1.9 and a range of 1–7 (Silber, 1990). Loose aggregations of vaquitas in which they were dispersed as single individuals or as small subgroups (from two to four members, greatest number eight to ten) throughout several hundred square metres were also reported (Vidal et al. 1999 and refs. therein).

Reproduction: Most calving apparently occurs in the spring (Jefferson et al. 1993). Gestation is probably 10–11 months. Maximum observed life span was 21 years (Rochas-Bracho and Jaramillo-Legoretta, 2002).

Food: All of the 17 fish species found in vaquita stomachs can be classified as demersal and/or benthic species inhabiting relatively shallow water in the upper Gulf of California, and it appears that the vaquita is a rather non-selective feeder on small fish and squids in this zone. Squid remains were also found in several stomach samples (Vidal et al. 1999).

5. Migration

There may be slight seasonal movements north (in winter) and south (in summer), but there is little supporting data. The former range may have included an area further south along the Mexican mainland (Carwardine, 1995). An analysis of all available sightings led Silber and Norris (1991) to suggest that vaquitas occupy the northern Gulf year-round.

6. Threats

Incidental catch: The most important human-induced problem affecting this species is incidental mortality in fishing gear. Vaquitas frequently die in illegal and sporadically permitted "survey-sampling" gill nets set for the endemic and endangered large corvinalike fish called the "totoaba" (*Totoaba macdonaldi*); in legal gill nets set for sharks, rays, mackerels (*Scomberomorus sierra* and *S. concolor*), chano (*Micropogonias megalops*) (a "croaker"), and shrimp (*Penaeus* spp.); and occasionally in commercial shrimp trawls. Between March 1985 and January 1994, 76 vaquitas were confirmed to have been killed incidentally in totoaba gill nets. All the porpoises taken in shrimp fisheries were referred to as "very small", probably calves or juveniles. Considering the large number (ca. 500) of shrimp boats operating in the upper Gulf of California at the beginning of each typical shrimping season, this fishery poses an additional threat to vaquitas, particularly younger ones (Vidal et al. 1999, and refs. therein).

Vaquita continue to be caught in small-mesh gillnet fisheries throughout much of the range. D'Agrosa et al. (2000) monitored fishing effort and incidental vaquita mortality in the upper Gulf of California from January 1993 to January 1995 to study the magnitude and causes of the incidental take. Of those factors studied, including net mesh size, soaktime, and geographic area, none contributed significantly to the incidental mortality rate of the vaquita, implying that the principal cause of mortality is fishing with gillnets per se. The total estimated incidental mortality caused by the fleet of El Golfo de Santa Clara was 39 vaquitas per year, which is over 17 % of the most recent estimate of population size.

Habitat degradation: In a recent meeting, the international committee for the recovery of the vaquita (CIRVA) agreed that in the long term, changes in vaquita habitat due to reduction of the Colorado river flow is a matter of concern and needs to be investigated (Rochas-Bracho and Jaramillo-Legoretta, 2002).

Pollution: Concerns have been expressed about organochlorine pollutants in the food web. However relatively low concentrations of total DDT, alpha-BHC, and PCBs were found in blubber samples analysed in 1985, and values were lower than those reported for various odontocetes and marine birds from most other areas (Vidal et al. 1999, and refs. therein).

7. Remarks

The vaquita is in imminent danger of extinction, and is listed as an endangered species. The population may number only a few hundred individuals, and at least 30 to 40 are killed each year, mainly in large mesh gillnets and in shrimp trawls (Jefferson et al. 1993).

Future development of the oil industry in the upper Gulf of California could also pose a serious problem for the vaquita and other species of marine organisms if a large oil spill occurred in that region, or if boat traffic as well as noise pollution were intensified.

Rojas and Taylor (1999) summarise that unfortunately, there is still disagreement over which factors put the species at greatest risk of extinction, hindering management decisions needed to reduce the risk to the species. They suggest that 1) habitat alteration from reduced flow of the Colorado River does not currently appear to be a risk factor because productivity remains high in vaquita habitat. 2) Pollutant loads are low and pose low to no risk. 3) Reduced fitness from inbreeding depression and loss of genetic variability are unlikely to currently pose a high risk , though risk will increase if vaquitas remain at low abundance over long periods of time. According to Rojas and Taylor (1999), mortality resulting from fisheries bycatch poses the highest risk and primary conservation efforts should be directed towards immediate elimination of incidental fishery mortality. One of the possibilities could be acoustic deterrents and their compulsory use in gillnet fisheries, provided that protected areas located nearly remain net-free (Culik et al. 2001).

The international committee for the recovery of the vaquita (CIRVA) strongly recommends:

- a reduction of vaquita by-catch to zero, by removing gill-net fisheries in three stages, starting with large mesh sizes,
- enforcement of fishing regulations,
- development and testing of alternative fishing gear,
- expansion of the southern limit of the Colorado River Delta Biosphere Reserve to include the entire range of the vaquita,
- banning of trawlers from the entire biosphere reserve,
- investigation of the abundance and seasonal movement of vaquitas via acoustic surveys,
- the design and development of public education and awareness programmes,
- investigation and development of strategies to offset economic hardships imposed by such regulations (Rochas-Bracho and Jaramillo-Legoretta, 2002).

D'Agrosa et al. (2000) further recommend:

- a maximum annual allowable mortality limit of vaquitas, and
- mandatory observer coverage of all boats fishing within the Upper Gulf of California and Colorado River Delta Biosphere Reserve.

For further recommendations on small cetaceans at risk, see also the account on spinner dolphins (*Stenella longirostris*).

Phocoena sinus is listed in Appendices I & II of CITES. It is considered "Critically Endangered" (CR C2b) by the IUCN based on the fact that C) the population is estimated to number less than 250 mature individuals and that there is 2) a continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of b) all individuals are in a single subpopulation.

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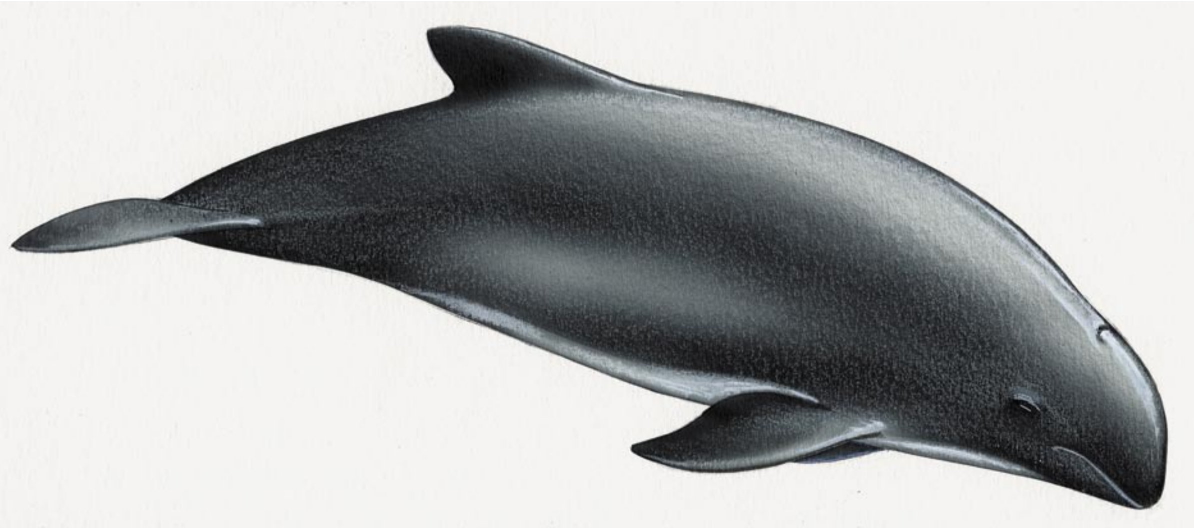
5.53 Phocoena spinipinnis (Burmeister, 1865)

English: Burmeister porpoise
German: Burmeister-Schweinswal
Spanish: Marsopa espinosa
French: Marsouin de Burmeister



Drawing of Phocoena spinipinnis © Wurtz-Artescienza.

1. Description

The body is robust with a small, blunt head and relatively large flippers. The dorsal fin is triangular in shape and canted backward in an unusual fashion for a cetacean. The Spanish name for this porpoise "marsopa espinosa" meaning "spiny porpoise" refers to the series of tubercles present in the dorsal fin. Coloration varies from dark to brownish grey on the back and sides, and a light grey on the ventral region. A dark patch often surrounds the eye. A dark grey stripe runs from the chin to the base of the flipper. A pair of stripes is also present on the abdominal region (Reyes, 2002).

Distribution of Phocoena spinipinnis: temperate and subantarctic coastal waters around South America (map mod. from Brownell and Clapham 1999; © CMS/GROMS).

2. Distribution

P. spinipinnis ranges on the west coast of South America from Paita (05°11'S), Peru, south to Valdivia (39°46'S), Chile; on the east coast of South America from Santa Catarina (28°48'S), Brazil, south to Chubut (42°25'S), Argentina; and in coastal waters around Tierra del Fuego (Rice, 1998).

Burmeister's Porpoise may be one of the most abundant small cetaceans living around the coasts of southern South America, but it is shy and easy to overlook, and so it is poorly known (Carwardine, 1995). Whether Burmeister's porpoise has a continuous distribution throughout its range is unclear. There are numerous gaps in the known distribution along both Atlantic and Pacific coasts, but it is likely that many or most of these simply reflect a lack of survey effort in the areas concerned (Brownell and Clapham, 1999).

3. Population size

There are no quantitative data on abundance. Burmeister's porpoise is very difficult to detect in any but calm conditions, a fact that may explain the discrepancy between the assumed abundance of this animal in coastal waters on the one hand and the relative rarity of field observations on the other. The animal's respiratory and diving behaviour does not lend itself to easy observation: swimming is highly unobtrusive, surfacing is quiescent, and relatively prolonged dives of 1–3 min are common (Brownell and Clapham, 1999).

4. Biology and Behaviour

Habitat: This is essentially a coastal species, which sometimes frequents rivers and estuaries and, off Tierra del Fuego, is occasionally observed inside the kelp line. Its habitat preferences seem to closely resemble those of the harbour porpoise, which is typically found shoreward of the 60 m isobath, but occasionally they have been recorded offshore in up to 1000 m of water (Brownell and Clapham, 1999 and refs. therein). However, there have also been records from more offshore waters, 50 km from the coast of Argentina (Reyes, 2002).

Burmeister's porpoise is found associated with a broad range of water temperatures. At the southern limit of its distribution near Cape Horn and Tierra del Fuego, water temperatures range from 3°C in June to about 9°C in the summer months. To the north, the species appears to be associated with temperate waters in the two major northward flowing currents of South America, the Humboldt and Falklands currents. The highest recorded temperature associated with a Burmeister's sighting was 19.5°C in Golfo San José, Argentina (Brownell and Clapham, 1999 and refs. therein).

Behaviour: A limited number of observations indicate that it is a very shy animal. Some records suggest that small groups scatter when frightened, or approached by a boat, and regroup later. It is believed to move very close to shore after dark (Carwardine, 1995).

Schooling: Very little is known about the natural history of this species. Most sightings are of less than 6 individuals, but aggregations of up to 70 have been reported. Behaviour of this species is inconspicuous; they breathe with little surface disturbance (Jefferson et al. 1993; Brownell and Clapham, 1999 and refs. therein).

Food: Feeding is on demersal and pelagic fish, such as anchovies (*Engraulis* spp.) and hake (*Merluccius gayi*), as well as squid (Jefferson et al. 1993), and the stomachs of some Chilean animals also contained small snails, crustaceans and mollusc egg capsules (Brownell and Clapham, 1999 and refs. therein). Further prey species are sardines, jack mackerel and drums (Reyes 2002).

Reproduction: There appears to be a protracted summer birth peak; most births in Peru apparently occur in late summer to autumn (Jefferson et al. 1993).

5. Migration

A year-round population of Burmeister's porpoise appears to exist in the Beagle Channel, suggesting site-fidelity; sightings have been made in every month except August and September. Data on seasonal movements are sparse and come largely from entanglements and incidental sightings. At Golfo San José, Argentina, *P. spinipinnis* is observed almost exclusively in spring and summer. This suggests that seasonal movement (either north-south or inshore-offshore) does occur, although whether this is correlated with water temperature or abundance of prey is unknown. Seasonal porpoise movements inferred from capture rates of the "corvina" fishery off Valdivia, Chile, with animals caught inshore (up to 18.5 km from the coast) in summer, and offshore (18-37 km) in winter, are biased by fishing methods: fishermen move their nets offshore in winter. Although it is unclear whether this by-catch truly reflects movements by the porpoises, it is possible that Burmeister's porpoises migrate offshore to match seasonal movements of potential prey, sardines (Brownell and Clapham, 1999 and refs. therein).

6. Threats

Direct catch: It is widely suspected that Burmeister's porpoises are shot or harpooned for use as crab bait in southern Chile. However, because quantitative data are lacking, the extent of this problem is unknown. The most extensive known takes occur in Peruvian waters, where Burmeister's porpoise is caught primarily in net fisheries, and where it has been used extensively for human consumption. Mortality in Peru was recently estimated as >450 per year and the high mortality is cause for considerable concern (Brownell and Clapham, 1999 and refs. therein; van Waerebeek et al. 1997). Reyes (2002) states that annual captures in Peru may reach as high as 2,000 animals (see also mundo azul in "selected web-sites").

Incidental catch: By-catch occurs in various areas within the species' range, including Peru, Chile, Argentina, Uruguay and Brazil. Coastal or shark gill net fisheries are also responsible for mortality in Burmeister's porpoise in Argentina (>12 per year), Tierra del Fuego, and, to a lesser extent, Uruguay. Takes are poorly documented in all areas (Brownell and Clapham, 1999 and refs. therein).

Pollution: There has been only one study of pollutants in this species on eight animals caught in gill nets off northern Argentina. Organochlorine levels in all animals were low, a finding which is consistent with the relatively low degree of pollution known from local waters (Brownell and Clapham, 1999 and refs. therein).

7. Remarks

Jefferson and Curry (1994) summarise that existing information is insufficient to evaluate the effects of gillnets on porpoise populations, but where this is possible, impacts often prove to be severe. Gillnets represent the single most important threat to porpoises as a group. Better documentation of catches and new approaches to dealing with porpoise/gillnet interaction problems are clearly needed in order to enable an assessment of the effects and suggest mitigation measures in the case of Burmeister's porpoise. Conclusions and recommendations for small cetaceans off South America: please see Hucke-Gaete (2000; c.f. Appendix 1).

The catches reported from fishing industries in Peru (for human consumption) and Chile (as bait in crab fisheries) are also causes for concern. Very little is known on migratory patterns, movements or home range. Range states include Peru, Chile, Argentina, Uruguay and Brazil.

Phocoena spinipinnis is considered as "Data Deficient" by the IUCN and is included in Appendix II of CMS.

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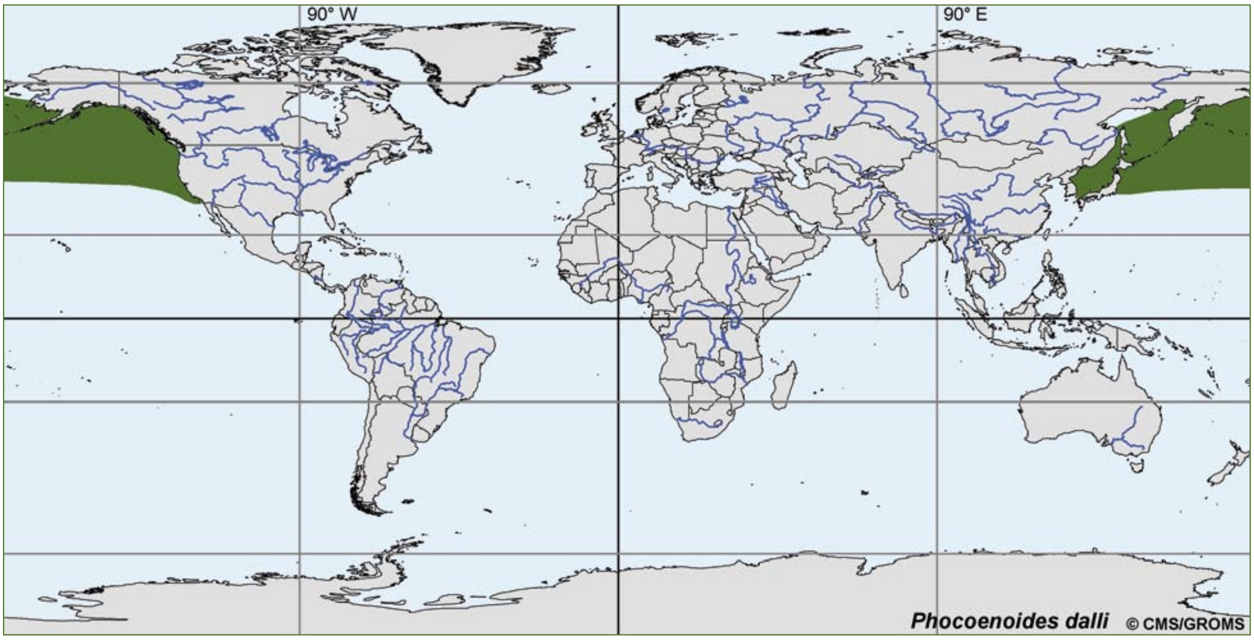
5.54 Phocoenoides dalli (True, 1885)

English: Dall's porpoise
German: Dall-Hafenschweinswal
Spanish: Marsopa de Dall
French: Marsouin de Dall

Drawing of Phocoenoides dalli © Wurtz-Artescienza.

1. Description

Like the other members of the phocoenid family, Dall's porpoise has a stocky body with a short, wide-based, triangular dorsal fin. The beak is very short and poorly defined. The flippers and fluke are small. The colour pattern is very characteristic, the animals being largely dark grey to black with a large, ventrally continuous white patch which extends up about halfway on each flank. The upper part of the dorsal fin and the trailing edge of the flukes are light grey. Dall's porpoises are polymorphic in their pigmentation pattern. In dalli type animals, the flank patch extends to about the level of the dorsal fin whereas in truei type animals the patch extends to about the level of the flippers. Maximum body length is 239 cm and mass 200 kg (Jefferson, 2002).



Distribution of Phocoenoides dalli: both east and west sides of the northern North Pacific, and in the open sea (mod. from Jefferson, 1999; © CMS/GROMS).

There is minor geographical variation in the colour pattern of Dalli-phase animals, with the most distinctive individuals in the Sea of Japan. Skull size also varies geographically, averaging smaller in animals from the open ocean than in animals from the Sea of Japan, the Sea of Okhotsk, the Bering Sea, and the coast of California (Rice, 1998). The results of McMillan and Bermingham (1996), who studied mtDNA variation in 101 Dall's porpoises from the Bering Sea and western North Pacific, support the demographic distinctiveness of Bering Sea and western North Pacific stocks. More recently, Escorza-Treviño and Dizon (2000) suggested from DNA-analyses that there are nine distinct dalli-type populations that should be treated as separate units for management purposes.

Hayano et al. (2003) investigated the genetic diversity and phylogenetic relationships among three morphologically distinct populations of Dall's porpoise in Japanese waters by analyzing mitochondrial DNA variation. These populations, the Sea of Japan-Okhotsk dalli-type population, the truei-type population and the standard dalli-type population in the northwestern North Pacific, are clearly discriminated from each other by differences in the size of their white flank patch. A total of 479 bp of the mitochondrial control region and flanking tRNA genes was sequenced for 103 individuals. Pairwise comparisons indicated a low but significant difference between the Sea of Japan-Okhotsk and the other two populations, whereas there was no significant difference between the latter. These results suggest that there is a close evolutionary relationship among these populations despite their consistent differences in coloration.

2. Distribution

The distribution of Dall's porpoise is confined to the North Pacific Ocean and adjacent seas. Geographical variation in the colour-phase ratio is sufficient to permit the recognition of two subspecies (Rice, 1998):

P. d. dalli: These populations consist of >99% Dalli-phase and <1% Truei-phase animals. They range in subarctic waters from the south-eastern Sea of Okhotsk, the southern Bering Sea, and the northern Gulf of Alaska, south to the Sea of Japan, the Subarctic Boundary at about 42°N across the North Pacific, and in the California Current to about 32°N off Baja California Norte, except in the area occupied by the next subspecies. Although mainly an offshore deepwater inhabitant, *P. d. dalli* also occurs in narrow channels and fjords where the water is clear and relatively deep, such as those in Prince William Sound and around the Alexander Archipelago in Alaska (Rice, 1998).

P. d. truei Andrews, 1911: This population consists of <5% Dalli-phase and >95% Truei-phase animals and ranges in a limited area of the western North Pacific immediately east of the southern Ostrova Kuril'skiye, Hokkaido, and the Sanriku coast of Honshu (Rice, 1998).

There are records of the species as far south as 28°N, off the coast of Baja California (Mexico) although reported only during periods of exceptionally cold waters. At the northern end of the range, sightings are infrequent north of 62°N in the Bering Sea, but there have been occasional sightings in the Chukchi Sea (Reyes, 1991, and refs. therein).

3. Population size

Several stocks have been recognised, based largely on geographic variation in morphology and colour patterns, parasite loads, densities of mother/calf pairs, and genetic differences. Eight stocks (seven dalli-type and one truei-type) are currently recognised by the International Whaling Commission (Houck and Jefferson, 1999 and refs. therein).

The most recent estimate for the North Pacific and Bering Sea is 1,186,000 (Buckland et al. 1993).

Recently, several estimates have also been produced for smaller portions of the species' range. These report 141,800 in the western North Pacific, 104,000 off Japan, (>50% truei-type), 554,000 in the Sea of Okhotsk (all three stocks), 2,150 along the west coast of the US, and 78,400 off California (Houck and Jefferson, 1999 and refs. therein).

4. Biology and Behaviour

Habitat: Dall's porpoise is found in diverse habitats, including sounds, nearshore waters (near deep water canyons) as well as offshore waters more than 1,000 km from shore. Waters colder than 18°C are preferred, and the peak abundance is in waters colder than 13°C (Reyes, 1991 and refs. therein). It may routinely forage at depths of 500 m or more (Carwardine, 1995). It is not found in the southern extremes of its range during the summer or warm water months (Houck and Jefferson, 1999). Ferrero (1998) confirms, that sea surface temperature was the most important habitat parameter examined.

Behaviour: Almost hyperactive. Darts and zig-zags around at great speed, and may disappear suddenly. Swimming-speeds can reach 55 km/h. This is the only porpoise that will rush to a boat to bow-ride, but soon loses interest in anything that travels slower than 20 km/h. They do not porpoise like other small cetaceans, but produce a "rooster tail" (Carwardine, 1995).

Schooling: Dall's porpoises are found mostly in small groups of 2 to 12, although aggregations of up to several thousand have been reported. Groups appear to be fluid, often forming and breaking up for feeding and playing (Jefferson et al. 1993). They often associate with Pacific White-sided Dolphins (from 50°N southwards) and Long-finned Pilot Whales (from 40°N southwards) (Carwardine, 1995). Bowriding behaviour has been observed with gray (*Eschrichtius robustus*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) (Houck and Jefferson, 1999, and refs. therein).

Food: The diet of Dall's porpoise is probably determined by size and abundance and consists primarily of small fish and squid (<25 cm). In Monterey Bay, Pacific hake (*Merluccius*), juvenile rockfish (*Sebastes*), and market squid (*Loligo*) made up 85% of the food items over the year. Off Japan, squid accounted for 11% of the food items; lanternfish were over 70% of the remainder. In the north-western North Pacific and Bering Sea mostly squid, as well as epi- and mesopelagic fish were consumed, including myctophids (lanternfish), with *Protomyctophum* accounting for 78% of all the fish. The high percentage of deepwater and vertically migrating fish in the diet of Dall's porpoises from many areas indicates that feeding occurred either at night or at great depths, most likely both (Houck and Jefferson, 1999 and refs. therein; Fiscus and Jones, 1999).

Amano and Kuramochi (1998) suggest from their findings, that Dall's porpoises feed opportunistically, changing prey items and feeding times based on supply. The most common prey items in the Sea of Okhotsk were the Japanese pilchard (*Sardinops sagax*) and the squid (*Berryteuthis magister*) (Walker, 1996). Around Hokkaido in the Sea of Okhotsk and the Sea of Japan, the dominant prey species switched from the late 1980s to the early 1990s as the *Sardinops melanostictus* (Japanese pilchard) populations in both seas declined. In the Sea of Japan, the diet of Dall's porpoises switched to *Theragra chalcogramma* (walleye pollock), and in the Sea of Okhotsk, their diet switched to *Engraulis japonicus* (Japanese anchovy) and *Berryteuthis magister* (magistrate armhook squid) (Ohizumi et al. 2000).

Reproduction: Most Dall's porpoise calves are born in spring and summer (Jefferson et al. 1993). Segregation of age and sex classes was determined in the western North Pacific population. Mother-calf pairs are sighted only north of 46°N. Data obtained from gillnet fishery confirm that pregnant and lactating females dominate in the northern Pacific area and that newborn calves are also present. These observations probably indicate a calving and breeding area for the population north of the United States Exclusive Economic Zone (EEZ). The percentage of mature males in this area is low, and most mature males are found south of the United States EEZ (Reyes, 1991 and refs. therein).

5. Migration

Although the species as such is present all year round in Prince William Sound, Alaska, a decrease in abundance of Dall's porpoises was observed from fall to winter, indicating a movement of a portion of that population out of the area. These seasonal migrations may also occur in the Gulf of Alaska and the Bering Sea (Reyes, 1991 and refs. therein). According to Forney and Barlow (1998) Dall's porpoises seem to shift their distribution southward during cooler water periods on both interannual and seasonal time scales. In southern California waters, Dall's porpoises were found only in the winter, generally when the water temperature was less than 15°C (Houck and Jeferson, 1999). Carretta et al. (2000) also found that Dall's porpoises were present off San Clemente Island, California, only during the cold-water months of November-April.

Houck and Jefferson (1999), suggest that this species is present year-round in central California, northern California, Puget Sound, Washington, and British Columbia. In these areas, waters remain cool (about 9–15°C) throughout the year. Inshore/offshore movements off Southern California and British Columbia have also been postulated.

Although movements in the eastern Pacific also have a north/south component, there appear to be more distinct north/south movements in the western Pacific. These movements may be temperature-related or food-dependent. Truei-type porpoises and mixed schools are generally found in warmer waters, while dalli-types are found in both warmer and colder waters (Houck and Jefferson, 1999 and refs. therein). Porpoises of the truei-type winter off the Pacific coast of Japan, moving in summer towards the north, reaching the southern Kuril Islands. Migration of truei-type animals into the Okhotsk Sea was recently confirmed, and it has been suggested that this occurs through the Kuril Islands. The presence of a higher percentage of mother-calf pairs in the southern part of that sea suggests that the area represents a breeding ground for the truei-type. Up to 15,000 animals of the dalli-type are reported to migrate through the Tsugaru Strait to the Pacific coast of Japan (Reyes, 1991 and refs. therein).

6. Threats

Direct catch: A fishery for Dall's porpoises operates only in Japanese waters and dates back to early in the 20th century. While this fishery was developed primarily during winter months, it has spread to other seasons and areas, resulting in an increase in the annual catch and the inclusion of the dall's-type in the captures. A total of 10,534 was taken in 1986, 13,406 in 1987, and about 39,000 in 1988 from a population of about 105,000 porpoises migrating to the fishing grounds. The stock composition of the catches is not known. The effect of hunting at such a level on the populations is a matter of concern (Reyes, 1991 and refs. therein). In recent years, the catch has been reduced somewhat, but still remains high, with 16,000 harpooned in 1994 (Houck and Jefferson, 1999 and refs. therein). The Small Cetaceans Subcommittee of IWC has attempted a review of the status of stocks of *Phocoenoides dalli* exploited by Japan. Because Japan refused to cooperate, on the grounds that small cetaceans were outside the remit of IWC, the subcommittee was unable to complete a full assessment of the status of the stocks (W. Perrin, pers. comm.).

Incidental catch: In addition to the direct catch, Dall's porpoises are captured incidentally to other fisheries. The most important is the Japanese mothership salmon gillnet fishery which has operated in the north-western North Pacific and Bering Sea since 1952. Because the area for the fishery is located mainly within the United States EEZ, restrictions were devised to reduce the incidental catch. The estimated annual incidental take within the United States EEZ for the period 1981–1985 ranged from 1,850 (1981) to 4,187 (1982). Outside the United States EEZ the take ranged from 479 to 1,716. A Japanese squid gillnet fishery was reported to take nearly 2,500 Dall's porpoises every year between 1982 and 1984. Two other squid fisheries, Korean and Taiwanese, operate in the area, but the number of porpoises taken incidentally remains unknown, although it may be high (Reyes, 1991 and refs. therein). A global moratorium on pelagic drift net fishing went into effect at the end of 1992, and should have reduced or eliminated these kills (Houck and Jefferson, 1999 and refs. therein).

Dall's porpoises were also taken in a Japanese land-based salmon gillnet fishery in the western North Pacific. Estimated annual take in this fishery for 1981 and 1982 were 2,966 and 6,099 respectively. In the eastern North Pacific a few animals were taken incidentally to other fishing operations (Reyes, 1991 and refs. therein), and in drift nets for tuna and billfish in the central Pacific. Dall's porpoises are taken occasionally in other types of fishing gear as well, such as in trawl nets along the west coast of the United States (Houck and Jefferson, 1999 and refs. therein).

Deliberate culls: No information is available (Reyes, 1991).

Pollution: High concentrations of organochlorines (especially DDT) were reported in Dall's porpoises from southern California (Reyes, 1991 and refs. therein). Females may transfer organochlorines to their offspring during gestation and especially through lactation, and testosterone levels in males may be reduced by high levels of PCBs and DDE. These findings suggest that current levels of contaminants in Dall's porpoise tissues may have detrimental effects on production and calf survival (Houck and Jefferson, 1999 and refs. therein; Jarman et al. 1996).

Overfishing: It is unlikely that the fishery for salmon could directly affect the food supply of Dall's porpoises, since salmon is not their regular prey. However, other fisheries operating in the North Pacific take a variety of fish species that could include potential prey species. The development of the squid fishery in the region could eventually represent a potential threat by reducing food availability (Reyes, 1991 and refs. therein).

7. Remarks

Concern has been expressed in the past regarding the direct catch of Dall's porpoises in Japanese waters. By 1987 the level of annual catches reached about 10% of the estimated 105,000 Dall's porpoises known to migrate to the fishing grounds. The number of Dall's porpoises taken by Japan in 1988 in the harpoon fishery was nearly 39,000, apparently in compensation for the shortage of whale meat attributed to the IWC moratorium on whaling. Further depletion of the stocks may have occured if the hunting pressure continued at the high levels reported. Studies on stock identity, biological parameters and abundance are urgently needed. The assessment of various fisheries in the North Pacific needs to be completed, in order to understand the actual impact of these fishing operations on the Dall's porpoise populations (Reyes, 1991).

Phocoenoides dalli is considered "Lower Risk, conservation dependent" by the IUCN. It is included in Appendix II of CMS because of extensive migrations/-movements of various stocks.

Range States are Canada, Japan, North Korea, People's Republic of China (including Taiwan), South Korea, the United States and Russia. Particular attention should be paid to studies on stock identity and size, as well as the monitoring of the incidental take by squid fisheries.

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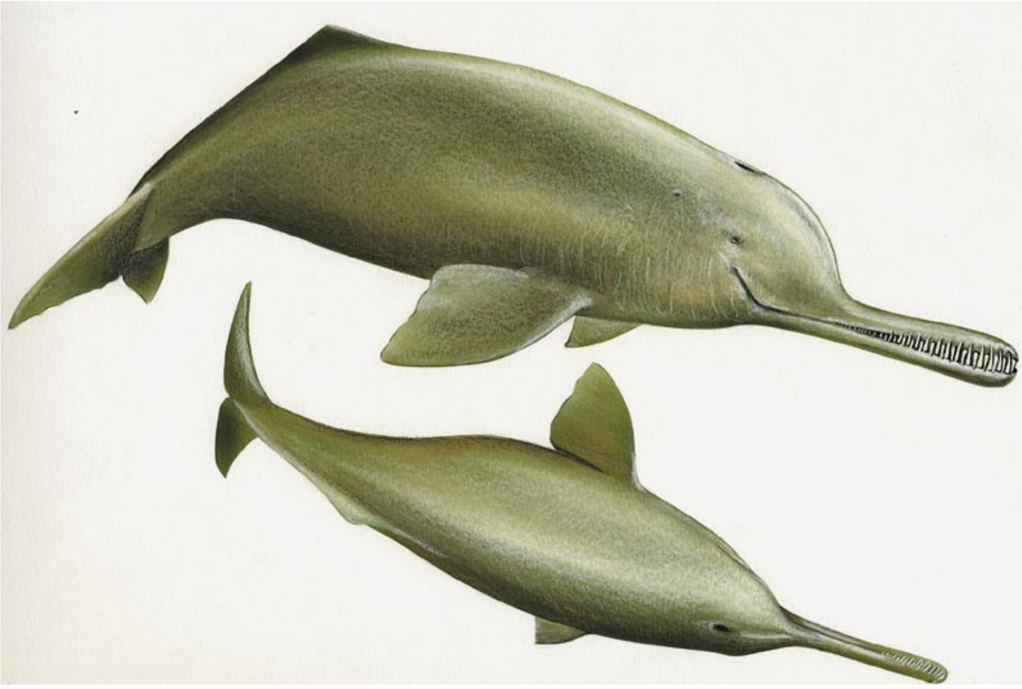
5.55 Platanista gangetica (Roxburgh, 1801)

English: Ganges river dolphin, susu
German: Ganges-Delphin
Spanish: Delfín del río Ganges
French: Plataniste du Gange



Drawing of Platanista gangetica © Wurtz-Artescienza.

1. Description

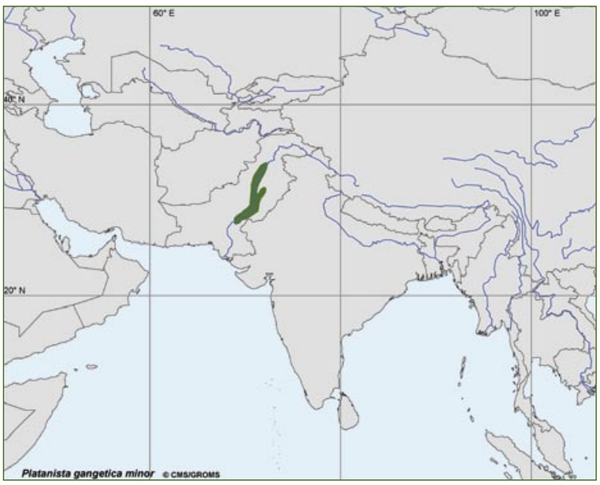
The body of the susu is subtle and robust, attenuating behind the dorsal fin to a narrow tail stock. The coloration is grey all over and becomes blotchy with age. The snout is long and widens at the tip. In females, the snout is generally longer and may curve upwards and to one side. The eyes are extremely small resembling pinhole openings slightly above the mouth. The dorsal fin is a low triangular hump. The broad flippers have a crenellated margin, with visible hand and arm bones. The flukes are also broad. Males are smaller than females, with 210 and 250 cm, respectively (Smith, 2002).

The Indus and Ganges populations were long regarded as identical until Pilleri and Gihr (1971, in Rice, 1998) divided them into two species, but Kasuya (1972, in Rice, 1998) reduced the two taxa to subspecies of a single species. This is supported by the results of Yang and Zhou (1999), who found that the difference between cytochrome- b sequences of Ganges and Indus river dolphins was very small. Even up until historical times there was probably sporadic faunal exchange between the Indus and Ganges drainages by way of head-stream capture on the low Indo-Gangetic plains, between the Sutlej (Indus) and Yamuna (Ganges) rivers (Rice, 1998 and refs. therein).

2. Distribution

Susus live exclusively in freshwater. There are two disjunct races:

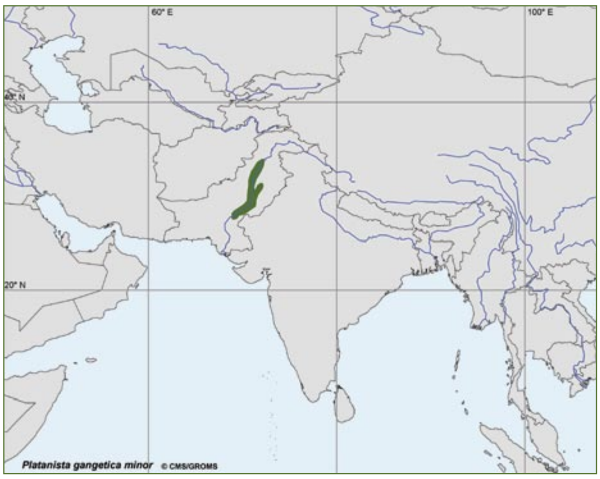
P. g. minor Owen, 1853: formerly ranged in the Indus River and its tributaries, the Jhelum, Chenab, Ravi, and Sutlej rivers, of Pakistan and India, from tidal limits to the foothills (Rice, 1998). The range is now limited to



Current main distribution of P. g. minor in the Indus and Chenab Rivers (mod. from Smith, 2002; © CMS/

the mainstream in three areas located between the Chasma-Taunsa, Taunsa-Guddu, and Guddu-Sukkur barrages (Reeves and Chaudry, 1998). A few scattered individuals may still occur upstream of the Chasma barrage in the Indus and downstream of the Trimmu, Sidhnai, and Pandjnad barrages in the Chenab, Ravi, and Sutlej rivers, respectively (Smith, 2000 and refs. therein; not shown on the map).

P. g. gangetica: Formerly distributed throughout the Ganges-Brahmaputra river system of India, Bangladesh, Nepal, and possibly Sikkim and Bhutan, below an elevation of about 250 m. In the Ganges valley it ranges into most of the major affluents, including some of their tributaries: the Son, Yamuna, Sind, Chainbal, Rainganga, Gumti, Ghaghara, Rapti, Gandak, Baginati, Ghugri, Kosi, Kankai, and Atrai rivers. In the Brahmaputra valley it also ranges into many of the major tributaries: the Tista, Gadadhar, Champamat, Manas, Bhareli, Ranga, Dihang, Dibang, Lohit, Disang, Dikho, and Kapili rivers. Downstream it ranges through most of the larger tributaries between the Hugh and Meghna rivers, as far as the tidal limits at the mouths of the Ganges. Also reported from the Fenny, Karnafuli, and perhaps the Sangu, rivers to the southeast of the mouths of the Ganges (Rice, 1998). Ganges River dolphins live not only in the main channels, but also during the flood season, in seasonal tributaries, and the flooded lowlands (Jefferson et al. 1993). The distribution is said to be restricted only by the lack of water and by rocky barriers (Reyes, 1991).



Main Distribution of P. g. gangetica in the Ganges-Brahmaputra and Karnaphuli-Sangu river systems (mod. from Smith, 2002; © CMS/GROMS).

3. Population size

Indus: According to a recent review by Smith (2000, and refs. therein) the largest sub-population is located in the Sindh Dolphin Reserve between the Guddu and Sukkur barrages at the downstream end of the species' range. The count for this segment in April/May 1996 was 458 individuals. The second largest sub-population is located between the Taunsa and Guddu barrages, and the count here was 143 individuals in December 1996. The count for the subpopulation at the upstream end of the species' current range between the Chasma and Taunsa barrages in December 1996 was 39 individuals. No dolphins were found during surveys below the Sukkur barrage in May/June 1996. A few scattered individuals may remain upstream of the Chasnia and Panjnad barrages (Reeves et al. 1991). Reeves (1998, in Smith, 2000) interpreted the counts reported above to indicate a total of approximately 600-700 individuals for the species as a whole.

Ganges: Formerly quite abundant, the overall population of Ganges river dolphins is reduced to probably fewer than 100 dolphins in Nepal, with the group of about 20 in the Karnali River above Chisapani being the largest single concentration. In the late 1980s it was estimated that 4,000–5,000 susus inhabited the four major sections of the species' range: 3,000–3,500 in the Gangetic deltaic zone, consisting of the Ganges below Farakka Barrage, the Brahmaputra below Tistamukhghat, and as far up the Meghna as Bairab Bazar; 500–750 in the Ganges River zone; 500 in the Brahmaputra River zone; and 750 in the Meghna River zone above Bairab Bazar. These figures do not appear to be based on a survey or any other kind of quantitative data, so they should be regarded as nothing more than informed guesses. About 45 dolphins were estimated in the Chambal River, a south-western tributary of the Ganges, in the early 1980s (Jones, 1982; Reeves and Brownell, 1989, Reyes, 1991 and refs. therein). In a more recent paper, Mohan et al. (1997) estimated the population of Ganges River dolphin in the river Brahmaputra from South Salmara to Sadiya to be 400. With an annual mortality of about 60, the population size has been reduced by 30 % over the past 10 years.

However, according to the IWC (2000) population assessment has generally been based on counts of dolphins on relatively small segments of rivers, with no estimates of precision.

4. Biology and Behaviour

Habitat: This species is exclusively riverine. In the river basins in India, the Ganges river dolphin is present mostly in plains where the rivers run slowly. This seems to be opposite to the habitat observed in Nepal, where the dolphin can be found in relatively clear waters and rapids. In both areas, however, there is a preference for deep waters (Reyes, 1991, and refs. therein). Smith (1993) identified primary and marginal habitats, according to differences in physical characteristics and sighting frequencies (0.57 and 0.13 sightings/visit for primary and marginal habitats, respectively). Primary habitats were characterised by an eddy counter-current system in the main river flow caused by a fine sand/silt point bar formed from sediment deposits of a convergent stream branch or tributary. Marginal habitats were characterised by a smaller eddy counter-current system caused by an upstream meander. Dolphins concentrated in locations of high prey availability and reduced flow. Susus have been found in water as cold as 8°C and as warm as 33°C (Reeves and Brownell, 1989 and refs. therein).

Schooling: Susus are not usually considered gregarious. In one of the few quantitative studies of group size, it was found that 90% of the groups and 80.4% of the total dolphins observed during the dry season in the Meghna and Jamuna Rivers of Bangladesh were solitary individuals. However, other investigators reported groups of up to 25 individuals near ferryboats in the Indus, or as many as 25–30 dolphins in a 1-km stretch of river. Relatively high densities of dolphins are found at sites where rivers join or just downstream of shallow stretches, in areas where the current is relatively weak, off the mouths of irrigation canals, and near villages and ferry routes. In the Indus, about 40–45% of the dolphin population is found at junctions of tributaries with the mainstream, at least during the dry season, presumably being attracted to these areas by concentrations of prey (Reeves and Brownell, 1989, and refs. therein).

Reproduction: Calving apparently can occur at any time of the year, but there may be peaks in December to January and March to May (Jefferson et al. 1993).

Food: Susus feed on several species of fish, invertebrates, and possibly turtles and birds. They do much of their feeding at or near the bottom, echolocating and swimming on one side (Reeves and Brownell, 1989; Jefferson et al. 1993).

5. Migration

The marked seasonal changes in susu distribution and density over much of its range are due, at least in large part, to fluctuations in water levels. During the dry season from October to April, many dolphins leave the tributaries of the Ganges—Brahmaputra systems and congregate in the main channels, only to return to the tributaries the following rainy season. They may become isolated in pools and river branches during the dry season (Reeves and Brownell, 1989).

Observations in Nepal show that susus' move in and out of tributaries of the Gandaki, Koshi, and Karnali systems during high water seasons, probably spending lower-water seasons in deep pools of the tributaries. In the main rivers, a decrease in abundance during the summer would confirm a seasonal pattern of migration (Shrestha, 1989, in Reyes, 1991).

6. Threats

Direct catch: *Indus:* Mohan and Kunhi (1996) suggested using fish oil in the catfish fishery on the river Ganges as a substitute for susu oil (Bairagi, 1999). Hunting of susus is now banned, but poaching still occurs occasionally (IWC, 2000).

Ganges: Deliberate killing of susus is believed to have declined in most areas but still occurs in the middle Ganges near Patna, India, in the Kalni-Kushiyara River of Bangladesh, and in the upper reaches of the Brahmaputra River in Assam, India (Mohan et al. 1997). Dolphins are killed in the upper Brahmaputra for their meat and by fishermen in the middle reaches of the Ganges for their oil, which is used as a fish attractant. The magnitude of direct take in recent years is unknown, but probably not high (IWC, 2000).

Incidental catch: *Indus:* Incidents of accidental killing and observations of dolphin carcasses and products are documented in Reeves et al. (1991) and Reeves and Chaudhry (1998). Little detailed information is available, but the level of take is not thought to be high, even though the Indus susu is vulnerable to gillnets. Permanent losses from the population also occur when animals swim into irrigation channels. Since 1992 there have been reports of one or two dolphins becoming trapped in these channels annually, but ten were recorded in the winter of 1999/2000 (IWC, 2000).

Ganges: Accidental killing is a severe problem for Ganges River dolphins throughout most of their range.

The primary cause is believed to be entanglement in fishing gear, most often nylon gillnets. Ganges River dolphins may be particularly vulnerable to entanglement in gillnets because their preferred habitat is often in the same location as primary fishing grounds. No rigorous estimates of dolphin mortality have been published but the problem of accidental killing is expected to worsen as the demand for fish and for fishing employment increases (IWC, 2000 and refs. therein).

Fishermen try to avoid entanglements because the dolphins may damage their nets. By-catches may occur in Nepal through the use of set and drift gillnets, snares, snag hooks, dynamite and a variety of poisons in fishing operations (Reyes, 1991 and refs. therein).

Deliberate killing: It has been suggested that some fishermen see Ganges river dolphins as rivals that scare away the fish or tear the fish from the nets. For this reason, the fishermen would scare the dolphins into the nets to kill them. This, however, is unlikely because the high cost in repairing the nets would not be compensated by selling the entire dolphin or its products (Reyes, 1991 and refs. therein).

Pollution: *Indus:* Pollution may be affecting the viability of the species, especially considering the decline in the flushing effect of moving water above barrages. Mercury and arsenic concentrations sampled from fish above the Guddu Barrage were high. Massive fish kills have apparently become common from industrial pollution in urban areas and the use of pesticides in the irrigated crops grown along the riverbank (IWC, 2000 and refs. therein).

Ganges: Pollution by fertilisers, pesticides, and industrial and domestic effluents is dramatic in the Ganges River: about 1.15 million metric tons of chemical fertilisers and about 2,600 tons of pesticides are dumped annually to the river system. Industrial effluents are also a source of increasing pollution in Nepal. The effects of pollutants may be considered deleterious to dolphin populations (Reyes, 1991, and refs. therein; Subramaian et al. 1999). Senthilkumar et al. (1999) determined concentrations of polychlorinated biphenyls (PCBs), hexachlorocyclohexane (HCH), chlordane compounds, and hexachlorobenzene (HCB) in river dolphin blubber and prey fishes collected during 1993 through 1996 from the River Ganges in India. Comparison of organochlorine concentrations with values reported for samples analysed during 1988 through 1992 suggested that the contamination by these compounds has increased in the river. Kannan et al. (1997) determined concentrations of butyl-tin compounds in dolphin, fish, invertebrates and sediment collected from the River Ganges. Total level in dolphin tissues was up to 2,000-ng/g wet wt, which was about 5-10 times higher than in their diet. The biomagnification factor for butyltins in river dolphin from its food was in the range 0.2-7.5. Butyltin concentrations in Ganges river organisms were higher than those reported for several persistent organochlorine compounds. Discharge of untreated domestic sewage was one of the major sources. River dolphins may be particularly vulnerable to industrial pollution because their habitat in counter-current pools downstream of confluences and sharp meanders often places them in close proximity to point sources in major urban areas (e.g. Allahabad, Varanasi, Patna, Calcutta, and Dhaka). Furthermore, the capacity of rivers to dilute pollutants has been drastically reduced in many areas because of upstream water abstraction (IWC, 2000).

Habitat degradation: *Indus:* The dramatic effects of human activities can be observed in the riverine ecosystems. The construction of three irrigation barrages, completed at Sukkur in 1932, at Kotri in 1955, and at Guddu in 1969, has had a devastating effect on susus in the Indus. The greatly reduced volume of water, particularly downstream of Sukkur Barrage, caused the dolphins' dry-season range to shrink. Subpopulations on either side of barrages are now isolated and thus are more vulnerable to extirpation by hunting or environmental change (Reeves and Bushnell, 1989). Due to water abstraction, the Indus river becomes virtually dry in several places in the low-water season, especially downstream of the Sukkur Barrage, thereby eliminating suitable habitat in the lower reaches. The greatest threat to the survival of the Indus susu is probably the continuing decline in water supply due to the construction of new diversion structures (e.g. Ghazi-Gariala (Barotha) Dam in the upper Indus) and from increasing extraction from aquifers. Increasing human populations and both industrial and agricultural development in the area immediately surrounding this dolphin's range will inevitably lead to even greater habitat loss or damage (IWC, 2000).

Ganges: Construction of dams for hydroelectric development and irrigation in the Ganges system has divided dolphin populations into small isolated subpopulations, preventing migrations and reducing food availability. The population above the Kaptai dam in the Karnaphuli River disappeared over a period of 6 or 7 years after the completion of the dam. The diversion of water for irrigation caused high fluctuations in the water flow, reducing suitable habitats for the dolphins. Similar effects are expected with dolphin populations In the Karnali River in Nepal, in addition to erosion of banks and changes In river beds, as a result of deforestation and mining. Heavy river traffic is increasing drastically In both India and Nepal, and this may result In habitat restriction and changes in feeding behaviour (Reyes, 1991 and refs. therein). The population of the Padma River system is said to be "fast declining" due to the construction of the Farakka Barrage (Reeves and Bushnell, 1989). Mohan et al. (1998) observed a land-locked susu population in the Kulsi river, a southern tributary of the Brahmaputra. Its number has come down from 24 animals in 1992 to 12 in 1995. Large scale sand extraction and operation of fishing gear hazardous to the dolphins were the main causes for the decline.

In addition to fragmenting dolphin populations, dams and barrages degrade downstream habitat and create reservoirs with high sedimentation and altered assemblages of fish and invertebrate species (IWC,-2000). Luxuriant growth of macrophytes and excessive siltation have eliminated suitable habitat immediately above the Farakka-Barrage.-The-insufficiency-of-water-released downstream of the barrage has eliminated dry-season habitat for more than 300 km, or until the Ganges (Padma)-Brahmaputra confluence (Smith-et-al.,-1998) and resulted in salt water intruding an additional 160 km into the Sundarbans Delta, further decreasing the amount of suitable habitat for this obligate freshwater species.

Other sources of habitat degradation include dredging (Smith et al. 1998) and the removal of stones, sand (Mohan et al. 1998), and woody debris (Smith, 1993). These activities threaten the ecological integrity of the riverine environments, especially in small tributaries where suitable habitat is more confined and therefore more vulnerable to local sources of degradation. Suitable habitat is also threatened by water abstraction from surface pumps and tube wells, especially in the Ganges where the mean dry-season water depth has been dramatically reduced in recent years. The long-term implications of the reduction of dry-season flows in the Ganges are catastrophic for the survival of susus. New projects that divert dry-season flow, such as the Kanpur barrage in the upper Ganges, continue to be constructed (IWC, 2000, and refs. therein).

7. Remarks

Platanista gangetica is listed in Appendix I and II of CITES and CMS.

Indus: According to the Scientific Committee of the IWC (2000) the dramatic decline in the range of the species, from the historical distribution of approximately 3,500 km of river length to a range of less than 700 km of river length (Reeves et al. 1991) occurred presumably after the mainstem and major tributaries were segmented by barrages built between the 1930s and early 1970s. This implies a decline in abundance, especially considering that carrying capacity within the current range has likely decreased. The diminishing water supply and the consequent reduction in available habitat implies a continuing population decline. The future of this dolphin species depends on Pakistan's commitment to protecting biological diversity in the face of escalating human demands on dwindling resources (Reeves and Chaudhry, 1998).

The subpopulation in Sindh Dolphin Reserve, between Sukkur and Guddu barrages, is relatively large and apparently well-protected. However, the small size of the reserve, its geographical position near the downstream end of the species range, and the political and economic instability of the area, taken together, mean that this subpopulation is at considerable risk. The need for additional reserves upstream of Guddu Barrage, to improve the prospects of the species' survival, is clear (Reeves et al. 1991). The species has a low absolute abundance and a reduced and geographically fragmented range. The IWC sub-committee concluded that there was no prospect of improvement in the quality of its habitat in the foreseeable future, and indeed every indication was that the status of this species would worsen still further (IWC, 2000).

Platanista g. minor is categorised as "endangered" by the IUCN (EN A1 acd, B1+2 abcde), due to A) an observed, estimated, inferred or suspected reduction of at least 50 % over the last 10 years or three generations, whichever is the longer, based on (and specifying) direct observation, a decline in area of occupancy, extent of occurrence and/or quality of habitat, and actual or potential levels of exploitation; and B) the fact that the extent of occurrence is estimated to be less than 5,000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following: 1) Severely fragmented or known to exist at no more than five locations. 2) Continuing decline, inferred, observed or projected, in any of the following: a) extent of occurrence, b) area of occupancy, c) area, extent and/or quality of habitat, d) number of locations or subpopulations, e) number of mature individuals. Because this subspecies formerly occurred, and some individuals possibly still occur in riverine systems of both Pakistan and India, inclusion in Appendix II of CMS should be considered.

The sub-committee (IWC, 2000) recommended for the Indus river dolphin:

- that future capture and safe release of cetaceans (from irrigation channels to the Indus river) be conducted with application of a protocol that has been reviewed by specialists with prior experience. Opportunities for conducting conservation-oriented research on rescued animals should be fully utilised. Priority should be given to monitoring survival and movement of released animals, particularly with regard to the effects of barriers and irrigation canals,

- that research be conducted to elucidate the possible effects of barrages and canal gates on dolphin movements, paying particular attention to the design of these structures,

- that surveys be further coordinated and standardised, so that conservation strategies can be prioritised and pursued at the metapopulation level. Surveys should include a strong emphasis on identifying and assessing the availability of suitable habitat and the distribution and magnitude of threats.

Ganges: There has been a dramatic decline in the extent of occurrence of Ganges susus, as well as in the quality of their habitat, especially in the Ganges river basin (IWC, 2000). This decline has been related to the construction, since the late 1950's, of an extensive network of barrages. The species is severely fragmented and additional barrages continue to be-built (e.g. Kanpur barrage on the Ganges mainstem). Continuing mortality from deliberate and accidental killing threatens an already diminished species. Further reductions in the extent of occurrence and area of occupancy of the species are expected.

Platanista g. gangetica is categorized as "endangered" by the IUCN (EN A1 acd). This is based on an observed, estimated, inferred or suspected reduction of at least 50 % over the last 10 years or three generations, whichever is the longer, based on (and specifying) direct observation, a decline in area of occupancy, extent of occurrence and/or quality of habitat, and actual or potential levels of exploitation. Seasonal migration in this species is known to involve river systems shared by India and Nepal, at least, and this subspecies is also listed in appendix II of CMS. A proposal for CMS Appendix I listing was tabled at the SC meeting in South Africa in 1999 (W. Perrin, pers. comm.) and has been accepted.

The sub-committee (IWC, 2000) concluded that the Ganges susu is almost certainly declining in numbers and will continue to do so as habitat degradation shows no sign of abating. The current population size has been reduced by an unknown amount compared to historical levels, but is still large enough to be viable in the long-term if adequate conservation measures were taken soon.

The sub-committee (IWC, 2000) recommended:

- that the distribution, abundance and habitat of Ganges susus be assessed in areas where adequate surveys have not been conducted hitherto (e.g. Sundarbans and Damodar river system). Particular attention should be paid to documenting threats during these surveys,

- that an evaluation of population discreteness be conducted of Ganges susus among river systems, with particular attention to dolphins in Karnaphuli-Sangu river systems,

- that the level and impact of direct and incidental catches of this species be assessed, with particular attention to the number of dolphins killed to support the use of their oil as a fish attractant.

Susu's are threatened in Bangladesh from the effects of dams, large embankment schemes, dredging, fisheries bycatch, directed hunting, and water pollution (Smith et al. 1998). The section of the Jamuna River located between the divergence of the Old Brahmaputra River and the confluence of the Padma River and the section of the Kushiyara River located between the Bangladesh-India border and the confluence of the Korangi River were considered to be priority areas for investigation because several water development projects have already been constructed and more are planned for the areas. Simth et al. (1998) sugest that feasibility studies should be conducted on designating dolphin/fish sanctuaries and creating artificial habitat or enhancing existing habitat in eddy countercurrent scour pools to mitigate deleterious impacts. Kumar (1996) warns that if the present trend of influx of industrial waste into the river Ganga continues, *P. gangetica* will be treated as a living fossil in the near future in India. To conserve the endangered Gangetic dolphins, possible measures such as continuous biomonitoring of river water, extensive research on ethology and reproductive biology, strict enforcement of Indian Wildlife Act as well as mass awakening of common people are recommended.

For Nepal, Smith et al. (1996) summarise that in the Karnali and Narayani river basins aquatic species are threatened with local extinction from the effects of habitat degradation, segregation of breeding groups by downstream barrages, incidental catches during fishing operations and declines in prey fish populations. A proposed high dam in the Karnali River would further aggravate the problem. Sinha et al. (2000) warn that the most threatened populations are those of Nepal, with the only remnant groups in the Karnali and Sapta Kosi rivers.

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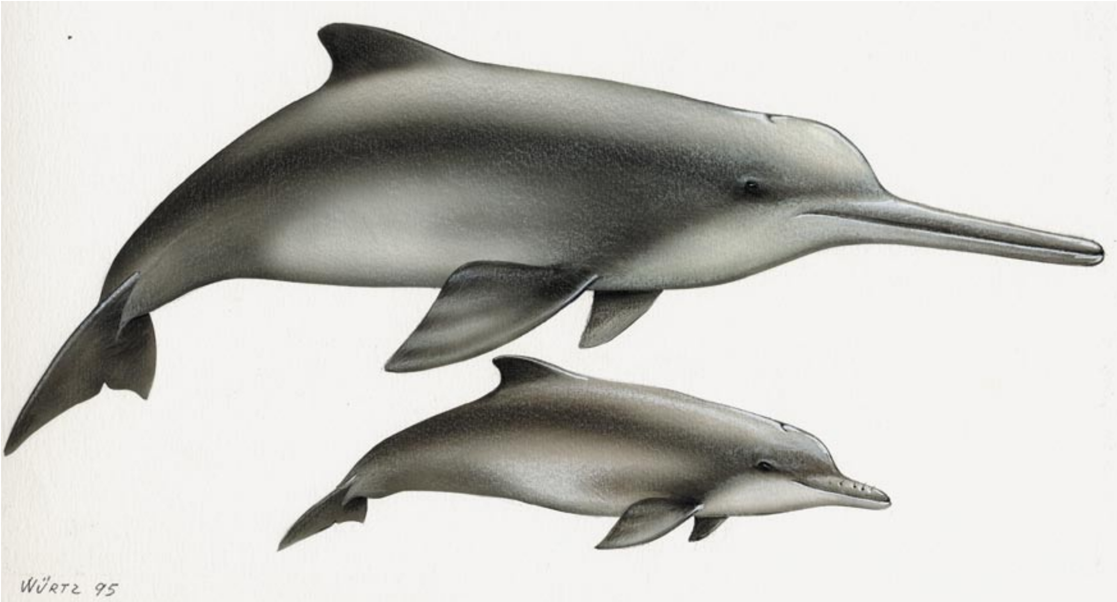
5.56 Pontoporia blainvillei (Gervais and d'Orbigny, 1844)

English: La Plata dolphin
German: La-Plata-Delphin
Spanish: Franciscana
French: Dauphin de la Plata



Drawing of Pontoporia blainvillei © Wurtz-Artescienza.

1. Description

The Franciscana is the only one of the four river dolphin species living in the marine environment. It is one of the smallest dolphins and has an extremely long and narrow beak and a bulky head. Its colour is brownish to dark grey above and lighter on the flanks and belly. Females are larger than males, ranging between 137-177 cm as opposed to 121-158 cm in males (Crespo, 2002).

2. Distribution

The franciscana is restricted to coastal central Atlantic waters of South America. The northern limit of the distribution is Itaúnas (18°25'S), Espiritu Santo State, Brasil (Crespo, 2002). In the south, the range extends to Golfo San Matías (41°10'S), in northern Patagonia, Argentina (Crespo, 2002). This limit would be determined by a transition area between the warm current of Brazil and the cold current of the Falklands/Malvinas. Here, the influence of continental run-offs from Rio Negro are observed as well as in the area of Bahia Anegada and the mouth of Rio Colorado (Crespo, 2000). Franciscana are relatively common on the Uruguayan side of the Rio de la Plata (Brownell, 1989 and references therein). The sighting of a single individual in Golfo Nuevo, Valdez Peninsula, is considered exceptional and this should not be considered the southern distribution limit for franciscana (Crespo, 2000).

Andrade (in Crespo, 2000) presented results on the use of gastrointestinal parasites as biological markers. This would distinguish two ecologically separate stocks 1) south of Brasil-Uruguay and 2) Argentina. These findings support those of earlier parasitologists (Aznar et al. 1995). These authors compared the helminth fauna of 46 franciscanas, from Necochea and Claromeco (Argentina) with previous records from Punta del Diablo (Uruguay) in order to establish whether the dolphins mixed freely between localities or formed isolated population units (stocks), at least temporarily. The nematode *Anisakis simplex* appeared in Argentina,

Geographic distribution of Pontoporia blainvillei on the east coast of South America (mod. from Crespo, 2002).

whereas *A. typica* did so in Uruguay only. This could be related to the geographic distribution of each species. There were also changes in the least common parasites and variations in the intensity of infection of the acanthocephalan *Polymorphus cetaceum*, and presumably, in the prevalence of the digenean *Hadwenius pontoporiae*. These results may be mainly explained by the environmental differences of each locality. However, as the sampling data differed between localities, temporal causes cannot be discounted for the quantitative variations. The overall results suggest that *P. blainvillei* might be sedentary, at least in spring-early summer, hence showing separate stocks, despite the relative closeness between localities.

Secchi et al. (1998) analysed genetic variability and report that of 11 haplotypes found, 5 were exclusive to franciscana from Rio Grande do Sul and 6 were found only in franciscana from Rio de Janeiro and no haplotypes were shared between locations. Reconstruction of the phylogenetic relationships among the haplotypes through a maximum-likelihood analysis of sequences revealed two distinct lineages that were consistent with the geographic sampling locations. Analysis of molecular variance and nucleotide diversity also showed this population structure. The genetic evidence indicated that at least two populations of franciscana exist along the coasts of Brazil. This was confirmed by Secchi (in Crespo, 2000) who noted that these distinct populations were first suggested by Pinedo in 1991 based on craneometric comparisons.

3. Population size

Summarising the results of a recent workshop, Crespo (2000) states that the population estimated for Rio Grande do Sul State between the coast and the 30 m isobath was about 4,000–4,500 individuals. The authors consider this estimate to be in the lower range of the population size. Furthermore, the best distribution limit is considered to be the 30 m isobath and not the 30 nautical milesline from the coast, because the depth and its relationship with diving and feeding would be the limiting factor.

Secchi et al. (2000) estimated that total abundance was 19,674 franciscanas for the whole Rio Grande do Sul and Uruguay coastal waters, considering the 30-m isobath as the offshore border. About 2.1–10.8 % of the population is presumebly removed each year by the fishery (see below).

According to Pinedo and Polacheck (1999) spring stranding rates in Rio Grande do Sul, Brazil, were generally high during 1979-81, declined to relatively low levels during 1982-85, increased again until 1987 and subsequently declined, with perhaps some increase again in the most recent years. While clearly recognising the limitations of attempting to infer changes in abundance from strandings data, one of the most likely explanations for declining stranding rates in the face of substantially increasing fishing effort would be a decline in franciscana abundance. As such, the strandings rate trends in conjunction with the effort trends are a matter of concern and the available information, while limited, suggests that an impact on the population of southern Brazil may have occurred.

4. Biology and Behaviour

Schooling: Herd size is small, ranging from 2 to 15 individuals (Crespo, 2002). Calves were recorded during spring and summer and only one calf was observed per group. The behaviour showed a seasonal pattern with co-operative feeding and travelling activities increasing during winter. Maximum depth of sightings was of 25 meters measured by nautical charts. Co-operative feeding increased during flood tide, while travelling decreased. The behavioural ecology of the franciscana appears similar to that of other coastal and river dolphins (Bordino et al. 1999 and Bordino, in Crespo, 2000).

Bastida (in Crespo, 2000) sighted 25 franciscana groups in spring and summer during 1976-1989 along the Mar del Plata coast, totaling 118 individuals. Group size averaged 4.8 with a maximum of 40 individuals at San Clemente del Tuyú. Crespo reported a group size of 1.17 individuals for Rio Grande do Sul.

In their study at Bahia Anegada, an area of 1,800 square km with the influence of Rio Colorado, Bordino and Iniguez (in Crespo, 2000) reported that the maximum number of individuals observed in a group was 13, divided in 3 subgroups. Studies started in 1992 and most of the sightings were performed during spring-summer.

Reproduction: Danilewicz (in Crespo, 2000) presented reproduction data from the northern coast of Rio Grande do Sul based on 22 females and 9 males and reported that births in this region occur during October to January with a water temperature over 20°C. He suggested that mating occurs in January and

February based on observations of ovaries with traces of recent ovulations. He found lactating females between October and January and that births coincide with the periods of higher abundances of main prey. All the individuals were sexually mature at the age of 3 years. No pregnant females were found nursing at the same time though the sample was small. Crespo (2002) estimates longevity at 15 y for males and 21 y for females.

Food: Analyses of stomach contents indicate that franciscanas consume a wide variety of mainly bottom-dwelling fish species (Brownell, 1989). Sciaenid and engraulid fish comprise the main prey items. Squid and shrimp are also reported. Animals examined in Uruguay had eaten fish species common in coastal waters of the mouth of the La Plata River (Reyes, 1991).

Although their diet included at least 24 species of fish in Brazilian and Uruguayan waters, a few species accounted for the majority of prey consumed. In Uruguay, the most important species (based on estimated biomass) were *C. striatus* during winter, spring, and summer, and *T. lepturus* during autumn. In Brazil, four sciaenids, *P. brasiliensis*, *C. striatus*, *M. ancylodon*, *M. Jurnieri*, and the squid (*L. sanpaulensis*) accounted for 87.7 % of the estimated biomass and 89.7 % of the total individuals ingested; 76 % of these were *C. Striatus* (Brownell, 1989 and refs. therein).

Ott (in Crespo, 2000) presented recent information from northern Rio Grande do Sul. He found that the main prey species are *Cynoscion guatucupa* (pescadilla, pescada), *Trichiurus lepturus* (pez sable, espada), *Urophycis brasiliensis* (brótola) and *Paralonchurus brasiliensis* (córvalo, maria-luiza) among the fish species and *Loligo sanpaulensis* among cephalopods. Feeding differences between sexes were not found but juveniles feed basically on shrimps. Franciscana feed on the most abundant species in the region and seem to change their diet according to seasonal prey fluctuations. He stressed that the role of cephalopods in the diet could probably be overestimated.

Bassoi (in Crespo, 2000) remarked on the importance of franciscana as a bioindicator of changes in fish stocks.

5. Migration

Reyes (1991) stated that apart from the documented intrusion into the La Plata River in search of prey, there is no additional information on movements of this species. The question whether franciscana is a migratory species could not be answered decisively by Crespo (2000) either.

In a first attempt to understand the behaviour of the franciscana in its natural habitat, Bordino et al (1999) and Bordino (in Crespo, 2000) recorded franciscana sightings from January 1993 to July 1997 from shore-based stations and vessels at Bahia Anegada, Argentina, near Rio Colorado. They recorded franciscana at a mean distance from shore of 3.2 km, and found them at a significantly greater mean distance from shore during winter. A positive correlation between the surface water temperature and the presence of franciscana was observed. Tide and depth also influenced behaviour. The animals usually enter the channels during high tide.

Pinedo and Polacheck (1999) analysed trends in stranding rates of franciscana for the 1979-1998 period from systematically collected data in Rio Grande do Sul, Southern Brazil. Strandings generally occur during spring, from September to December. This is the main period when the artisanal bottom- tending gillnet fisheries are active. However, strandings have occurred in all months, indicating that at least some franciscanas remain in the area year-round.

6. Threats

Incidental catch: Brownell (1989) and Reyes (1991) report on high incidental mortality of franciscana in fishery by-catch in the 1980's.

Praderi (in Crespo, 2000) presented data updating franciscana mortality records along the coasts of Uruguay, showing a decrease in mortality since the 1970's. The highest value for the 1990's was 235 individuals in 1992-93, while during 1998, only 23 individuals were recorded. The reasons for the decline of the catch include the drop in fish stocks. At present, this fishery is not profitable. The fisheries using nets with larger mesh, the most harmful for franciscana (32-34 and 20–22 mm) have reduced their effort and nets with smaller mesh (12–14 mm) are being used at present. Uruguayan legislation protecting the marine fauna including franciscana (Law 9481 and Decrees 26 1/78, 586/79 and 565/81) is being enforced.

However, the Uruguayan stock could be connected with individuals from the South of Brazil where incidental catch is currently high.

Zanelatto (in Crespo, 2000) presented information on incidental catches of franciscana in the area of Paraná. The work started in 1990 and relatively low catch values were recorded. The highest values of franciscana catches were recorded in winter, presenting a direct relationship with the catch values of specific species of fish in the region.

Monzón (in Crespo, 2000) commented that since 1991 there was no information on franciscana mortality in the area of Necochea (Buenos Aires Province). She noted a significant decrease in gillnet fishing effort from 50 vessels in the early 90's to only one at present. Coastal fishing in small communities (for example Santa Teresita), however, results in the highest mortality values of the region.

Ott (in Crespo, 2000) presented CPUE calculations (calculated as per 1,000 metres of net by day in the water) of franciscana for fishing communities of Tramandai and Torres on the northern coast of Rio Grande do Sul. He presented a figure of 425 individuals a year for the fishing fleet of 30 vessels operating 75–100 days/year. These estimates are appreciably higher than figures based on stranded individuals. Most of the animals were juveniles with an average age of one year and 64 % of the individuals were under 3 years.

Secchi and Ott (in Crespo, 2000) reported that by-catch in the northern region of Rio Grande do Sul is ten times higher than in the southern region and suggested that the 30 m isobath would explain these differences. Secchi et al. (1998) estimated an annual capture of about 460 franciscanas by the Rio Grande coastal gillnet fleet. The lack of abundance estimates, the unknown stock structure and the regular mortality of the species in gillnets (particularly immature animals) are reasons for concern.

According to Crespo (2002) mortality in Uruguay used to number 400 individuals per year and dropped to around 100 per year in the last few years for economic reasons. In Rio Grande do Sul and Buenos Aires fisheries, an estimated 700 and 500 are currently taken per year, respectively. The estimated total mortality throughout the range could be in the order of 1,500 per year. The highest estimates of abundance, however, cannot sustain the lowest estimates of incidental catches (Crespo, 2002).

Pollution: According to Brownell (1989) ratios of DDT to DDE in the blubber of franciscana were at least an order of magnitude higher than in small cetaceans from California. This indicates the use of pesticides, which entered the coastal marine ecosystems in southern Brazil and Uruguay. PCBs were the only residues detected in muscle and brain tissues.

As opposed to this, Crespo (2000) summarizes that franciscana seem to be one of the cetacean species least contaminated by heavy metals and chlorinated hydrocarbons. This fact may be related to their diet which is based mainly on juvenile fish. Junin (in Crespo, 2002) did not recommend the use of this species as a bioindicator of the status of the coastal environment. However, the use of liver levels to evaluate de DDT/DDE relationship was recommended.

According to Crespo (2002) a large proportion of the distributional range is subject to pollution from several sources, especially agricultural land use and heavy industries between Sao Paolo in Brazil and Bahía Blanca in Argentina.

Habitat degradation: Heavy coastal traffic and pollution from industrial development represent potential threats for the habitat of the franciscana. Recent widespread deforestation and agricultural cultivation are present in many of the basins draining into the Rio de La Plata system, particularly in southeastern Brazil. Fish species of commercial value normally constitute the diet of franciscanas, so an increase in the fishing effort for these fish could reduce available food for the dolphins (Reyes, 1991 and references therein). The coastal zone frequented by the Franciscana is also intensively used for boat traffic, tourism, and artisanal and industrial fishing operations (Crespo, 2002).

7. Remarks

Participants in a CMS meeting held in 2000 (Crespo, 2000) considered it essential to prepare an integrated conservation plan which includes work with the pertinent authorities, fishing communities, public awareness, environmental education and legislation review.

Argentina and Uruguay are members of the CMS convention. Brazil is considering to join CMS.

Franciscana was included in Appendices I and II of the CMS Convention, because the convention considers as migratory those species regularly crossing national jurisdictional borders. Appendix I includes migratory endangered species. Franciscana was added at the meeting of the Conference of the Parties held in April 1997, after a presentation made by Uruguay.

It was suggested during a recent CMS workshop (Crespo, 2000) that Argentina, Brazil and Uruguay consider the possibility of developing a Memoradum of Understanding for franciscana conservation within the framework of the CMS. Participants agreed to consider franciscana as the most endangered small cetacean in the Southwestern Atlantic. The endemism of franciscana and its restricted distributional area are important conditions for the species besides the high impact of human activities. Main concerns for franciscana conservation are the higher rates of incidental mortality in artisanal fisheries thoughout the area of distribution as well as chlorinated hydrocarbon and heavy-metal spills as a result of the industrial and agricultural activities in the coastal zone.

The species is listed as "Data Deficient" by the IUCN.

In Crespo (2000) open questions related to the franciscana were identified as: 1) area-dependent rate of incidental mortality in fishing activities, 2) unknown population/stock status and size, 3) information on life cycle, histopathology, ecology, behaviour and home range, and 4) habitat degradation and pollution. These are in essence the same questions identified ten years earlier by Reyes (1991).

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5.57 Pseudorca crassidens (Owen, 1846)

English: False killer whale
German: Kleiner Schwertwal
Spanish: Orca falsa
French: Faux-orque

Drawing of Pseudorca crassidens © Wurtz-Artescienza.

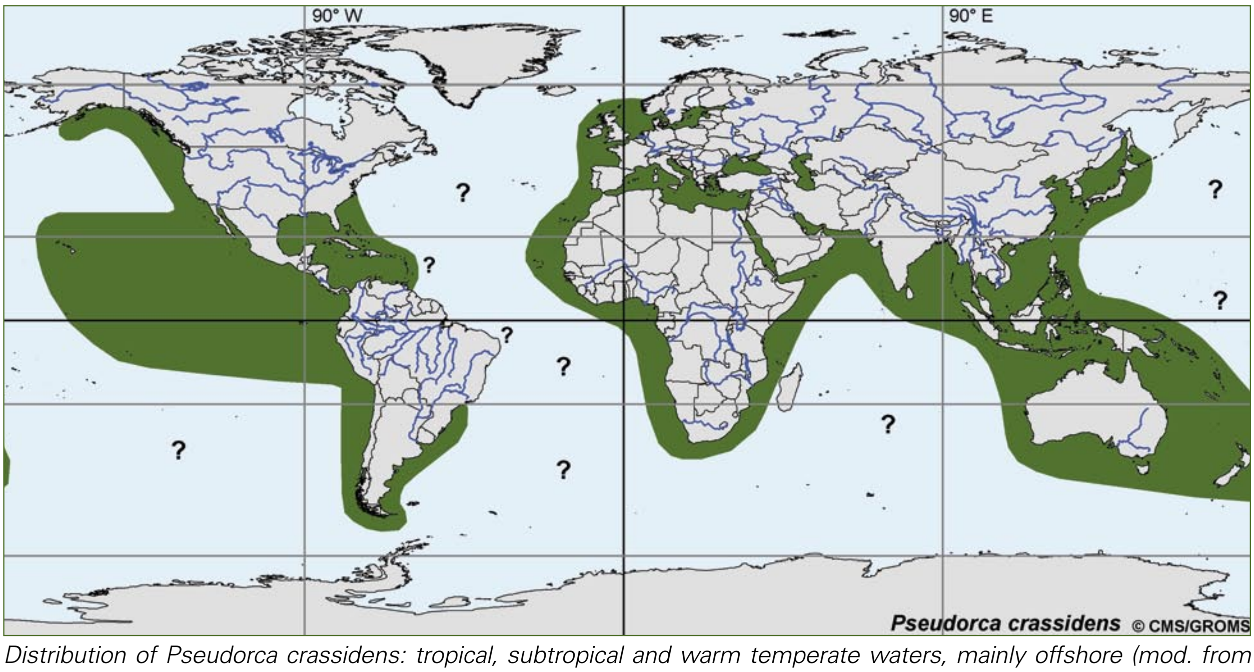
1. Description

False killer whales are large members of the delphinid family, adult males reaching 6 m, while adult females reach 5-m in length. The skull is similar to that of *Orcinus orca* (see page 204), but the two species don't seem to be closely related. The colour is largely black or dark grey, with a white blaze on the ventral side between the flippers. The head is rounded, the body shape elongate, the dorsal fin falcate and positioned in the middle of the back. In males, the melon protrudes further forward than in females (Baird, 2002)

Kitchener et al. (1990) found substantial differences in cranial characters between false killer whales from Australia, Scotland, and South Africa, but recognition of any subspecies would be premature (Rice, 1998).

2. Distribution

P. crassidens is found world-wide in tropical and temperate waters. It ranges north to Maryland, Scotland, southern Japan, Hawaii, and British Columbia and south to Chubut in Argentina, Cape Province, Western



Distribution of Pseudorca crassidens: tropical, subtropical and warm temperate waters, mainly offshore (mod. from Odell and McClune, 1999; Notarbartolo di Sciara 2002; © CMS/GROMS).

Australia, South Australia, Tasmania, South Island of New Zealand, Chatham Islands, and Concepción, Chile (Rice, 1998).

The false killer whale is widely distributed, though not really abundant anywhere (Carwardine, 1995) and generally does not range beyond 50° latitude in either hemisphere (Jefferson et al. 1993). Most of the distributional records and many of the data available for the species are the result of strandings (Odell and McClune, 1999). In the South Pacific, the distributional area may have to be extended further west than indicated on the map, based on sightings by Aguayo et al. (1998) between Chile and Easter Islands (112°W and 91°W). There are numerous records of animals seen in cool temperate waters, although these appear to be outside the normal range. Wanderers have been recorded as far afield as Norway and Alaska (Carwardine, 1995).

3. Population size

There is no estimate of world-wide abundance. Population estimates of 16,000 have been reported for the coastal waters of China and Japan (Odell and McClune, 1999 and refs. therein).

4. Biology and Behaviour

Habitat: *P. crassidens* is mainly seen in deep, offshore waters (and some semi-enclosed seas such as the Red Sea and the Mediterranean) and sometimes in deep coastal waters. It seems to prefer warmer temperatures (Carwardine, 1995). Off Hawaii, both shallow (less than 200 m) and deep water (greater than 2000 m) habitats have been reported for the species. *P. crassidens* appears to be relatively common off the Japanese coast. With the exception of sightings from the eastern tropical Pacific, data on distribution are lacking for most oceanic areas (Odell and McClune, 1999, and refs. therein).

Behaviour: The False Killer Whale readily approaches boats and is an exceptionally active and playful animal, especially for its large size (Carwardine, 1995).

Schooling: Sightings of groups of 10–20 individuals are common and group sizes as high as 300 have been reported, presumably forming when food is abundant. Herd size in recent mass strandings ranged from 28 to over 1,000 animals, and a mean herd size of 55 has been reported from Japanese waters. Mass stranded herds have about equal numbers of males and females of various sizes. False killer whales may associate with other species, e.g. bottlenose dolphins and other small cetaceans, possibly indicating shared or overlapping feeding grounds (Odell and McClune, 1999).

Reproduction: No seasonality in breeding is known for the false killer whale (Jefferson et al. 1993).

Food: Although false killer whales eat primarily fish and cephalopods, they also have been known to attack small cetaceans and, on one occasion, even a humpback whale (Jefferson et al. 1993). Depending on location, stomach contents included salmon (*Oncorhynchus* sp.), squid (*Berryteuthis magister* or *Gonatopsis borealis*) sciaenid and carangid fish, bonito (*Sarda* sp.), mahi mahi or dolphin-fish (*Goryphaena*), yellowfin tuna (*Thunnus albacares*), yellowtail (*Pseudosciana* spp.) and perch (*Lateolabrax japonicus*), mackerel, herring and smelt (Odell and Miller McClune, 1999, and refs. therein). Koen-Alonso et al. (1999) examined the stomachs of false killer whales from both coasts of the Strait of Magellan, Chile. The most important prey were the oceanic and neritic-oceanic squids, *Martialia hyadesi* and *Illex argentinus*, followed by the neritic fish, *Macruronus magellanicus*. The prey species were subantarctic, with two Antarctic species, abundant over the Patagonian shelf and adjacent oceanic waters around Tierra del Fuego. There are reports that *Pseudorca* fed on and chased other dolphins in the eastern tropical Pacific during chase and backdown operations of tuna purse seine fishing, a habit that has also been attributed to the pygmy killer whale (*Feresa attenuata*), see page 64, (Odell and McClune, 1999, and refs. therein).

5. Migration

Migration is not well documented, although it has been suggested that closely related globicephalid whales including *Globicephala*, *Pseudorca* and *Grampus* species in the western North Pacific move from warmer, southern waters in winter to cooler, northern waters in summer. Apparent seasonal movements in the western North Pacific may be related to prey distribution. False killer whales have been seen travelling in line formation and one large herd of about 300 individuals was distributed over an area several miles long and half a mile wide. Reported travelling speeds are 3–6 knots and as high as 10 knots (Odell and McClune, 1999, and refs. therein).

6. Threats

Direct catch: *Pseudorca* are occasionally taken in Japan for food and in St. Vincent Island, Caribbean for meat and cooking oil (Jefferson et al. 1993; Odell and McClune, 1999).

Incidental catch: Incidental take of small numbers of false killer whales in gill nets has occurred off northern Australia, the Andaman Islands, the southern coasts of Brazil and in tuna purse seines in the eastern tropical Pacific. Dolphin entrapment in tuna purse seine nets may be providing artificial feeding opportunities for *Pseudorca* on other marine mammals (Odell and McClune, 1999). Yang et al. (1999) report on by-catch rates in Chinese coastal fisheries (trawl, gill and stow net) which may number in the hundreds per year for *P. crassidens* alone.

Killing: The largest documented fisheries interaction is in the waters around Iki Island, Japan, where over 900 false killer whales were killed in drive fisheries from 1965 to 1980 in an attempt to reduce interactions with the yellowtail (*Pseudosciaena* spp.) fishery (Jefferson et al. 1993; Odell and McClune, 1999).

Pollution: High levels of pesticides (DDE) and heavy metals (mercury) were detected in stranded specimens and one individual had the remains of a plastic jug in its stomach (Odell and McClune, 1999 and refs. therein).

7. Remarks

This is a poorly known species which, although mostly observed over deep water, is known to strand from many coasts. Abundance estimates as well as by-catch data do not exist, nor are there detailed accounts on migratory behaviour. Clearly, more research is needed. See more recommendations for South American populations in the Hucke-Gaete (2000) report in Appendix 1 and for southeast Asian populations in Perrin et al. (1996) see Appendix 2. *P. crassidens* is not listed by the IUCN or CMS .

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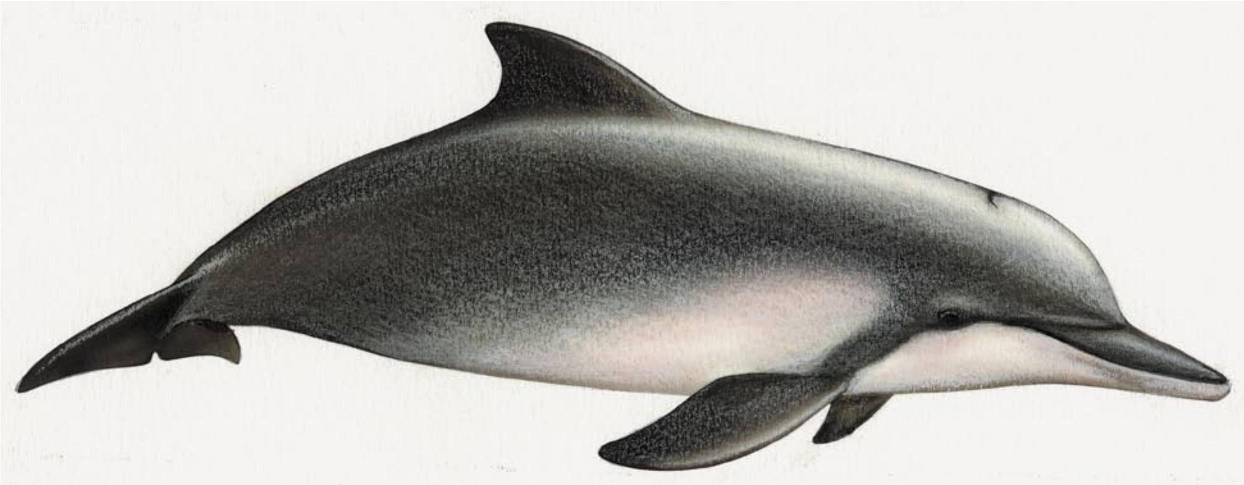
5.58 Sotalia fluviatilis (Gervais and Deville, 1853)

English: Tucuxi; bouto dolphin
German: Amazonas-Sotalia
Spanish: Delfín del Amazonas; boto, bufeo
French: Sotalia, dauphin de l'Amazon



Drawing of Sotalia fluviatilis © Wurtz-Artescienza.

1. Description

The appearance of the tucuxi resembles that of a smaller bottlenose dolphin. The tucuxi is light grey to blueish-grey on the back and pinkish to light grey on the belly, with a distinct boundary between the mouth gape and the flipper's leading edge. On the sides, there is a lighter area between the flippers and the dorsal fin. The dorsal fin is triangular and may be slightly hooked at the tip. The beak is moderately slender and long. Body size reaches 210–220 cm in marine and 152 cm in riverine ecotypes (Flores, 2002).

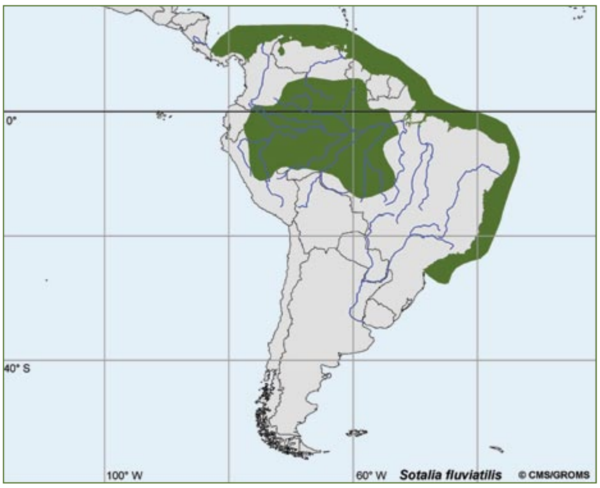
2. Distribution

Sotalia fluviatilis is found in both salt and fresh water. The coastal range extends from Florianopolis, Brazil, north into the Caribbean Sea as far as Panama. In a recent paper Carr and Bonde (2000) extend the known range some 800 km to the northwest in northeastern Nicaragua, north of the mouth of the Layasiksa River, west side of Waunta Lagoon (13°40'N) where one individual was positively identified as *S. fluviatilis* using diagnostic keys (not shown on map). Riverine animals are found from river mouths to about 250 km up the Orinoco and 2,500 km up the Amazon, mainly in estuaries and bays, and in deep river channels or flood-plain lakes (Carwardine, 1995).

The freshwater Amazonian populations and the coastal marine populations are separable as subspecies; the population in Lago de Maracaibo, Venezuela, also differs somewhat from either (Rice, 1998 and refs. therein).

S. f. guianensis (P.-J. van Bénéden, 1864) is found in inshore coastal waters, estuaries, and the lower reaches of rivers, along the western Atlantic from eastern Panama south to Floreanópolis, Santa Catarina, Brazil, with a (disjunct?) population on the coast of Honduras and the Costa de Mosquitos of northern Nicaragua. This subspecies includes *Sotalia brasiliensis* E. van Bénéden, 1875 (Rice, 1998 and references therein).

S. f. fluviatilis is exclusively freshwater and lives in the Amazon River and most of its tributaries below an elevation of about 100 m. This subspecies includes *Sotaliapallida* (Gervais, 1855) and *S. tucuxi* (Gray, 1856) (Rice, 1998 and references therein).



Distribution of Sotalia fluviatilis: shallow coastal waters and rivers of north-eastern South America and eastern Central America (mod. From Flores, 2002; © CMS/GROMS).

The separation of *Sotalia fluviatilis* into two subspecies is supported by Furtado (1999). He examined the degree of genetic variation in marine and riverine *Sotalia* from Brazilian waters. A unique genotype found only in *Sotalia* from the Amazon River suggests that the freshwater form may be genetically distinct from the marine form. The species is genetically diverse in the marine environment, but the occurrence of a common genotype in all six coastal locations examined along the marine coast suggests that there is sufficient gene flow in the marine region to prevent local differentiation.

3. Population size

There are no estimates of abundance for any population, although the species appears to be relatively abundant throughout its range. Numerous estimates exist of relative abundance in small areas, such as minimum number sighted, encounter rate, and estimates of minimum density (IWC, 2000).

The little information available on the abundance or status of *Sotalia* populations comes mainly from qualitative assessments in small geographical areas. Bossenecker (1978, in da Silva and Best, 1994) estimated 100-400 dolphins near the mouth of the Magdalena river in Colombia, and noted that they were abundant in the Gulf of Cispata, near San Antero (Colombia). In Suriname, they were described as "rather common" in the mouths of the larger rivers, and in Guyana they were reported as "frequent" in the lower reaches and mouth of the Essequibo river. *Sotalia* were reported to be common in the Baia de Guanabara (Rio de Janeiro), by Geise (1991, in da Silva and Best, 1994) who estimated the population at 418 individuals in about 109 groups. However, more recent estimates using photo-identification only come to a number of 69–75 individuals for the same region (Pizzorno, 1999 in Flores, 2002). Geise (1989, in da Silva and Best, 1994) estimated the total number of individuals for the area around Cananéia Island to be 2,829.

In the Amazon drainage area, an average density of approximately 1.1 dolphins per km of river was estimated between Manaus and Tefé in the Solimöes river. In the Iquitos area, Kasuya and Kajihara (1974, in da Silva and Best, 1994) recorded 62 *Sotalia* during 36 hr of observations. Further upstream, *Sotalia* were frequently encountered in the Samiria river and its tributary the Santa Helena river. They are also common in Colombia in the Loretoyacu river, and the Tarapoto river at the El Correo Lake system and in the lower reaches of the Orinoco river (da Silva and Best, 1994 and refs. therein).

Vidal et al. (1997) conducted a boat survey in 1993 to estimate the abundance of the tucuxi along ca. 120 km of the Amazon River bordering Colombia, Peru, and Brazil. They estimate that there are 409 *Sotalia* in the study area. *Sotalia* density (dolphins per km^2) was highest in lakes (8.6), followed by areas along main banks (2.8) and around islands (2.0). These are among the highest densities measured to date for any cetacean

Edwards and Schnell (2001) found that in the Cayos Miskito Reserve, Nicaragua, mean group size was 3. They estimate that 49 *Sotalia* inhabited the portions of the Reserve studied.

4. Biology and Behaviour

Habitat: Marine *Sotalia* show a preference for shallow protected estuarine waters or bays. In the Baia de Guanabara (Rio de Janeiro), *Sotalia* prefer the deeper channels (25 m depth) and avoid areas with less than about 6 m of water. Where the rivers that feed such areas are large enough, dolphins may penetrate up to 130 km or more upriver. For the marine form the major restriction to the south seems to be low sea-surface temperature (Reyes, 1991 and refs. therein).

Non-random clumping of sightings of *Sotalia* groups in the Cayos Miskito Reserve, Nicaragua indicates that some areas were preferred. In both Pahara inlet and Wauhta lagoon, sightings were more frequent in the afternoon than in the morning. In coastal areas *Sotalia* were sighted most often within 100 m of shore and the animals were seldom observed in more than 5 m of water (Edwards and Schnell, 2001).

Riverine *Sotalia* inhabit all types of water ("white water", "clearwater", and "blackwater" rivers) of the Amazon region, so physical factors such as visibility and pH appear not to affect their distribution directly. Riverine *Sotalia* are found in the main channels of rivers as well as in larger lakes where access is not limited by a narrow or shallow channel. They generally do not enter the flooded forest. Rapids and fast-moving turbulent water are also avoided. *Sotalia* show a distinct preference for junctions of rivers and channels (da Silva and Best, 1994 and references therein).

Schooling: According to da Silva and Best (1994) the two forms of *Sotalia* have a similar social structure.

The marine form is reported to occur in groups of as many as 30 individuals, with a mode of 2 per group in the Baia de Guanabara and Cananéia. Group size varies in these two areas according to the time of day and type of activity. Borobia (1984) and Geise (1984, 1989, both in da Silva and Best, 1994) reported that in the marine form, calves are usually observed in small groups of three (one calf and two adults) or four (two calves and two adults).

The riverine form occurs in groups of one to six individuals in 55 % of the observations. Groups of more than nine animals are seen on rare occasions. Group composition is unknown. Two groups that were captured consisted of a female with a male calf, and the third of a pregnant female with an immature female (da Silva and Best, 1994). Vidal et al. report overall mean group size of 3.9 individuals in the upper Amazon river.

Reproduction: In Brazil, calving in the riverine form apparently occurs primarily during the low water period, October to November. Little else is known of the species' reproduction (Jefferson et al. 1993).

Food: Marine *Sotalia* from south-east Brazil feed on a diet of pelagic clupeids (*Trichurus lepturus* and *Pellona barroweri*), demersal sciaenids (*Cynoscio* spp., *Porichthys porosissimus*, *Micropogonias furnieri*) and neritic cephalopods (*Loligo* spp. and *Lolliguncula brevis*). In Santa Catarina these dolphins are known to feed on the anchovies which are abundant in this area (da Silva and Best, 1994).

In the Amazon region, *Sotalia* prey upon at least 28 species of fish belonging to 11 families. The characoid family Curimatidae was represented in 52 %, Sciaenidae in 39 % and siluriforms in 54 % of the stomachs analysed (n = 29) . In the dry season fish become concentrated in the main water bodies, and thus are more vulnerable to predation. During the flood period many of these fish enter the floodplain to feed, and *Sotalia* usually do not enter this habitat (da Silva and Best, 1994).

5. Migration

General patterns: Marine *Sotalia* may penetrate up to 130 km or more upriver. The marine form probably also has a defined home range, although the area covered may be large because of the distances between one estuary or protected bay and another (Reyes, 1991). Geise (1989) and Andrade et al. (1987) observed individuals identified by natural marks in the same area for over 1 year (both in da Silva and Best, 1994).

The principal limiting factor in the Amazon is the presence of rapids and small channels, where manoeuvrability would be restricted. The large seasonal fluctuation in river levels (10 m) influences the distribution of *Sotalia*: they enter lake systems during periods of high water but will leave these as the waters recede, thus avoiding entrapment in lakes that are too small or shallow. Animals may occur during the whole year in the same area. Two tagged individuals in the Amazon were found within 5 km of the tagging site up to 1 year later (da Silva and Best, 1994 and references therein; Jefferson et al. 1993). Two types of travelling were observed: slow directional movement and faster swimming, including porpoising, usually in a single direction (Jefferson et al. 1993). It is possible that riverine tucuxis have a limited home range, but the area of such a range is unknown (Reyes, 1991).

Diurnal rhythms: An apparent diurnal behaviour rhythm has been observed in the two forms. Studies in the Amazon demonstrated that more *Sotalia* were seen between 09:00 and 10:00 h than at any other time (da Silva, unpublished data), and there was a marked movement into lakes from rivers in the early morning before about 09:00 h, and again in the late afternoon from about 16:00 to 18:00 h. Other authors also reported a distinct diurnal rhythm whereby *Sotalia* entered the Bahía de Guanabara between 06:00 and 08:00 h and left between 13:00 h and 18:00 h, but were rarely seen entering and leaving the bay on the same day (12% of the observations). A similar behaviour was reported for *Sotalia* in the Cananéia region (da Silva and Best, 1994 and references therein; Geise et al. 1999). Seasonal movements may also occur, although they do not seem to be very extensive (Reyes, 1991 and ref. therein).

At Enseada do Mucuripe in Fortaleza, Brazil the distribution of sightings and displacement routes of *Sotalia fluviatilis* suggested preferential uses of the sites Praia Mansa and Praia de Iracema on different timings, suggesting movement patterns from resting and feeding areas respectively. Largest and smallest frequencies of sightings at Praia de Iracema occurred respectively at the first and fourth quarters of the day. Largest frequencies happened at low tide (Oliveira et al. 1995).

6. Threats

Direct catches: There are no records of past or recent commercial fisheries for *Sotalia* (IWC, 2000). The freshwater dolphins have been protected by the superstitions of fishermen from Colombia to southern Brazil as well as in the Amazon. On the coast of Brazil *Sotalia* may occasionally be killed for use as bait for sharks or shrimp traps or for human consumption, although the extent of this practice is unknown. There is also a small market for the eyes and genital organs, which are used as love charms when prepared in a special manner (Jefferson, 1993; da Silva and Best, 1994 and refs. therein).

Incidental catches: Modern fishing practices and the greatly increased intensity of fishing in both the marine and freshwater habitats of this dolphin are the greatest direct threats to the species. *Sotalia* is easily captured in monofilament gill nets as well as in shrimp and fish traps and seine nets. Analysis of the type of fishing gear associated with the mortality of 34 *Sotalia* from the central Amazon revealed that 74 % were caught in gill nets and 15 % in seine nets. *Sotalia* apparently do not steal fish from nets as do *Inia* in the Amazon but, as they consume 14 of the 30 species of fish most exploited by man in the Amazon, incidental captures during fishing are frequent. In Atafona (Rio de Janeiro State, Brazil) *Sotalia* are the dolphins most frequently caught incidentally in fisheries (da Silva and Best, 1994 and refs. therein; da Silva and Best, 1996).

Beltran (1998, in IWC, 2000) recorded 938 animals taken in drift nets from the port of Arapiranga during the summer of 1996 and a further 125 taken during the winter. These data were collected by interviewing fishermen in the port after trips and collecting carcasses. The animals were generally large and may therefore have been the marine form, but this has not yet been confirmed. The sub-committee expressed its concern about the magnitude of these catches.

Da Silva and Best (1996) found that competition between man and dolphin for commercial fish is still minimal in the Central Amazon. Dietary analysis has shown that only 43 % of 53 identified prey-species are of commercial value and that the dolphins generally prey on size-classes of fish below those of commercial interest. Interviews with fishermen in the boats, in the fishmarket and in the shops supposedly selling dolphin products were conducted in an attempt to quantify the overall incidental kill attributed to commercial fisheries operations. The results showed that in the Central Amazon dolphin catches are incidental and only a very small number of these carcasses are used for commercial purposes.

Habitat degradation: Another potential threat to *Sotalia*, in both riverine and coastal environments, is the damming of rivers for hydroelectric projects, with future plans for up to 200 such dams in series along many of the main Amazon tributaries. At the very least, such dams would interrupt gene flow between *Sotalia* populations, creating isolated groups between dams. Furthermore, most of the migratory fish on which *Sotalia* feed would become extinct in the reservoirs, and the potential suitability of nonmigratory fish for the diet of *Sotalia* is unknown. Where such dams are built on rivers that empty directly into the sea, different problems arise. The altered flux of freshwater may affect both the primary and secondary productivity in the estuaries and reduce the feeding potential of these areas for *Sotalia* (da Silva and Best, 1994, Jefferson et al. 1993).

Pollution: Pollution from industrial and agricultural activities may be considered a threat both directly, through the destruction of habitat, or indirectly, through contamination of the food chain. Large harbours like the Baia de Guanabara (Rio de Janiero) and Santos (São Paulo) are extremely polluted with effluent, including heavy metals, posing a serious potential threat. The continued use of insecticides containing substances banned elsewhere is common in South America. Mercury is used in the refining of fluvial gold and then, like the pesticides, probably enters the aquatic food chain of the rivers. Mercury and selenium were found in the livers of two *Sotalia* from Suriname. Exploration for oil in the offshore regions of Brazil, Venezuela and Colombia may not pose a direct threat to *Sotalia*. Nevertheless, the apparent dependence of this dolphin on estuaries means that an oil spill near such an area could contaminate the food chain and affect local populations (da Silva and Best, 1994 and ref. therein).

7. Remarks

According to Monteiro et al. (2000) the small number of individuals in conjunction with long gestation and nursing periods, suggest that an increased mortality due to dolphin-fisheries interactions could severely impact local populations. The IWC sub-committee (IWC, 2000) recognised that incidental catches of tucuxi are widespread.

Sotalia fluviatilis is listed in Appendices I&II of CITES and in Appendix II of CMS. The species is listed as "Data Deficient" by the IUCN.

The tucuxi is abundant and widely distributed in the central Amazon, but there are no estimates of total population size. It is vulnerable to the same threats that apply to *Inia*, including fisheries entanglement, habitat deterioration and fragmentation of populations by dam construction. The large numbers of animals taken as incidental catches in the Amazon estuary are a cause for concern, though it is not yet clear which form of *Sotalia* these represent. Little information exists regarding the marine form of this species, and in many areas, such as the Orinoco, it is not clear which form exists. At present the two forms of the tucuxi should be considered as separate populations for conservation purposes (IWC, 2000, and refs. therein).

The IWC sub-committee (2000) recommends:

- that research should be directed towards detecting trends in abundance by making repeatable and statistically rigorous estimates of density in a range of regions and habitats,

- that information be collected to allow evaluation of the relative levels of incidental mortality of the tucuxi associated with different fishing methods,

- that research be directed to determine which form of tucuxis occur in areas such as the Orinoco and Amazon estuaries.

Recent studies based on dolphins inhabiting rivers show how vulnerable these marine mammals are to human activities. The tucuxi is not an exception, and current efforts to protect river dolphins should include this species. National legislation specifically protects the tucuxi in Brazil, Peru, and Colombia. The species is indirectly protected in Ecuador, Venezuela, Guyana, and French Guiana; specific information for Suriname is not available. However in the latter, as in the majority of countries within the range, nature reserves may protect the habitat (Reyes, 1991, and refs. therein).

The tucuxi is present in rivers of the Amazon region that cross territories of such countries as Brazil, Colombia, Ecuador and Peru. They definitely cross international boundaries in areas such as Leticia, as Amazon river dolphins do. On the Atlantic coast of South America, large rivers are geographical limits for countries along the coast. Because of the estuarine preference of tucuxis in the area, it is likely that the dolphins move between some of these countries (Reyes, 1991, and refs. therein).

Range States are Brazil, Colombia, Ecuador, French Guiana, Guyana, Nicaragua, Panama, Peru, Suriname and Venezuela. Efforts should be made to address the stock identity, and to minimise the potential threats to this species resulting from increasing development in the region (Reyes, 1991, and refs. therein).

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5.59 Sousa chinensis (Osbeck, 1765)

English: Indo-Pacific-humpbacked dolphin, Chinese white dolphin
German: Chinesischer Weißer Delphin
Spanish: Delfín blanco de China
French: Dauphin blanc de Chine

Drawing of Sousa chinensis © Wurtz-Artescienza.

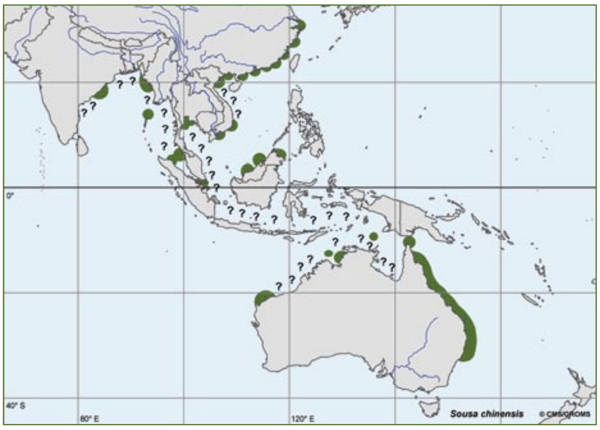
1. Description

Humpback dolphins are medium sized and robust. Their melon is slightly depressed and slopes gradually to an indistinct junction with the long, narrow beak. The broad flippers are rounded at the tip and the flukes are broad and full, with a deep median caudal notch. The form of the dorsal fin varies geographically. Body length reaches 2.5–2.8 m in different parts of the range. In South Africa, males may reach 2.7 m and 260 kg as opposed to the smaller females which only attain 2.4 m and 170 kg. Colour also varies greatly with age and location, in both the timing and extent in the loss of the grey background colour to become white (pink when flushed; Ross, 2002).

For the purpose of this review, I have followed Rice (1998) who separates the Genus *Sousa* into three species. However, other authors only recognise two: *S. teuszii* (see page 274) and *S. chinensis* (e.g. Jefferson and Karczmarski, 2001). Recent morphological studies, supported somewhat equivocally by genetic analyses, indicate even that there is only one single, variable species for which the name *S. chinensis* has priority. More recent genetic evidence suggests that Sousa is a member of the delphinid family (Ross, 2002).

2. Distribution

The Chinese white dolphin is discontinuously distributed in coastal waters of the western Pacific. According to Rice (1998), known areas of occurrence include the coast of southern China, including Taiwan, from the Gulf of Tonkin to Jiangsu, entering the lower reaches of the Zhu Jiang (=-Canton River), the Jiulong Jiang (=-Amoy River), and the Mim Jiang (=-Foochow River), and ascending 1,200 km up the Chang Jiang (=-Yangtse River) as far as Wuhanthe Gulf of Thailand; the Strait of Malacca; the northwestern coast of Borneo from Sematan in Sarawak to Sandakan in Sabah; the northwestern coast of Western Australia between North West Cape and Larrey Point; and the coast of eastern Australia from Cairns in Queenland to Wollonggong in New South Wales. Now also known from the



Distribution of Sousa chinensis: shallow coastal waters of the Western Pacific Ocean (mod. from Jefferson et al. 1993; Rice, 1998; © CMS/GROMS).

Philippines (W. Perrin, pers. comm.) According to Rice (1998), this species account includes *Sousa borneensis* (Lydekker, 1901).

According to Jefferson et al. (1993) the western limit of the distributional area is the east coast of Africa, but see account on *S. plumbea* (page 269) (Rice, 1998).

3. Population size

Corkeron et al. (1997) review the distribution and status of Indo-Pacific hump-backed dolphins in Australian waters. Records of stranded animals indicate that the species occurs along the northern Australian coastline. Mark/recapture analysis of photo-identification data from Moreton Bay in south-east Queensland indicated that hump-backed dolphins occurred at a density of approximately 0.1 dolphin per km^2. Relevant data on the status of humpbacked dolphins in Australian waters are scarce, but it is difficult to interpret the available information optimistically. By analogy with sympatric (and better studied) dugongs, Corkeron et al. (1997) suggest that hump-backed dolphins may be in decline in Australian waters.

Jefferson and Leatherwood (1997) conducted line transect surveys to examine the distribution and abundance of *Sousa chinensis* in Hong Kong waters between November 1995 and May 1997. Dolphin sightings occurred in all of the waters surrounding Lantau Island, but were most common in the North Lantau area. Estimates ranged from 88 dolphins in spring to 155 dolphins in autumn, with a year-round average of 109. Preliminary mark-recapture estimates of abundance from photo-identification data suggest that between 208 and 246 different individuals use the Hong Kong area. Jefferson and Karczmarski (2001, and refs. therein) summarise, that >1,028 animals occur in Hong Kong waters and the adjacent Pearl River Estuary.

Liu and Huang (2000) recorded 392 individuals in 700 km^2 of Xiamen waters. Animals may swim upstream to the Jiulong River but never swim out of Jinmen Island and Wuyu Isle. Generaly, the dolphins were sighted very close to the shore and most frequently occured in areas west of the harbour of Xiamen and the mouth of Tong'an Bay. The population has the tendency to decrease.

There are no further population estimates for any of the regions where the species exists, although it is always reported as common (Reyes, 1991).

4. Biology and Behaviour

Habitat: According to Carwardine (1995) *Sousa chinensis* is rarely found more than a few kilometers from shore, preferring coasts with mangrove swamps, lagoons, and estuaries, as well as areas with reefs, sandbanks, and mudbanks. Animals sometimes enter rivers, though rarely more than a few kilometers upstream and usually within the tidal range. They prefer water less than 25 m deep and, on more open coasts, are typically found in the surf zone (Ross, 2002).

Aerial surveys of the Great Barrier Reef region demonstrate that humpbacked dolphins occur throughout the region, mostly in waters close to the coast, although they also occur in offshore waters that are relatively sheltered, and close to reefs or islands (Corkeron et al. 1997).

Behaviour: According to Carwardine (1995) and Ross et al. (1994) the species is usually quite difficult to approach and tends to avoid boats by diving and reappearing some distance away in a different direction. They rarely permit a close approach before diving, splitting up into small groups or single animals.

Schooling: Off southern China schools usually contain three to five animals. In Moreton Bay, Queensland, mean group size was 2.4 animals (range 1–9, n =9) (Ross et al. 1994). *S. chinensis* associates with Bottlenose Dolphins and, to a lesser extent, with Finless Porpoises and Long-snouted Spinner Dolphins.

Reproduction: Some calves may be born throughout the year, but spring or summer calving peaks are the norm. Gestation lasts 10–12 months and age at sexual maturity is 10 years in females and 12–13 years in males (Jefferson and Karczmarski, 2001).

Food: Stomachs of two dolphins netted off the northern Queensland coast contained fish remains, and in one, some crustacean fragments. In Moreton Bay, south-east Australia, humpback dolphins feed with bottlenose dolphins on trawl discards (Ross et al. 1994 and refs. therein). According to Ross (2002) Food consists mainly of fish and cephalopods, dolphins temporarily beaching to retrieve bonefish washed onto exposed sandbanks.

5. Migration

Humpback dolphins appear to be present throughout the year off southern China and northern Queensland

(Ross et al. 1994). However, stranding rates differ between various seasons (with peaks during the summer monsoon), which seems to indicate variable dolphin densities and possibly seasonally differing habitats (Parsons, 1998a).

Parsons (1998b) found that resident populations of Indo-Pacific hump-backed dolphins in Hong Kong were present year-round in the waters to the north of Lantau Island and to the south during the summer monsoon season. Seasonal changes in abundance were significantly correlated with water temperature (positively) and salinity (negatively). Changes in the outflow of the Pearl River influence hump-backed dolphin distribution in the western waters of Hong Kong. Seasonal distribution appears to be linked with reproductive cycles and hydrography. Diurnal patterns and tidal state affect the abundance of this species

According to Parsons (2002a) the Pearl River, the largest in southern China, has a dramatic effect on the hydrography of the region, notably with regard to turbidity, salinity, pH, tides, currents and temperature of the waters of Hong Kong and Lingding Bay. Consequently the dramatic increase in its freshwater output during the summer also changes fish distribution, which in turn influences the abundance distribution of Hong Kong's Pacific humpback cetaceans.

6. Threats

By-catches: Dolphins are caught in shark nets set to protect bathing beaches along the coast off Queensland and New South Wales (Reyes, 1991). Accurate catch data for humpback dolphins in the Australian nets are unavailable, though six of 10 dolphins examined by Heinsohn et al. (1980, in Ross et al. 1994) were taken from shark nets. Some specimens were taken in an offshore driftnet fishery operating off northern Australia (Reyes, 1991, and references therein).

Habitat degradation: The disposal of contaminated mud arising from Hong Kong's dredging and reclamation projects poses a risk to the Chinese White Dolphin via the consumption of seafood/marine prey species (Clarke et al. 2000). Acoustic disturbance results from industrial activity underwater, such as pile-driving during land-reclaim as in the construction of Hong Kong Kai Tak airport. Würsig et al. (2000) report on the successful development of an air bubble curtain to reduce underwater noise of percussive piling.

Boat traffic seems to interfere with acoustic communication between the animals (Parijs et al. 2001). However, in Hong Kong waters, no obvious changes in humpback dolphin behaviour were noted in response to boat traffic. Hong Kong is one of the busiest ports in the world: approximately half a million oceanic and river-going vessels travel through Hong Kong's waters every year and thirty high speed and hydrofoil ferries pass through the area of greatest humpback dolphin abundance daily (Parsons, 1997a). With such a high volume of shipping traffic it is understandable that the animals may have become more habituated to its presence. However, between 1993 and 1998 three Pacific humpback dolphin strandings were diagnosed to have been killed by boat strikes and another dolphin mortality was suspected to have been caused by a boat strike (Parsons and Jefferson, 2000). This represents 14% of all humpback dolphin strandings during this period (Parsons and Jefferson, 2000).

Pollution: The concentrations of organochlorines in cetaceans from Hong Kong coastal waters were significantly higher than those found in various seals collected from other parts of the world. Correlations between the concentrations of tris-chlorophenyl compounds with other persistent organochlorines such as HCHs, CHLs, DDTs and PCBs were significant, suggesting their bio-accumulation (Minh et al. 1999)

Hong Kong's population of Indo-Pacific hump-backed dolphins inhabits an area where a high volume of sewage waste discharge and the close proximity of contaminated mud pits mean a considerable potential for trace metal contamination (Parsons 1998c). Concentrations of arsenic, chromium, lead, molybdenum and nickel in dolphin tissues were an order of magnitude lower than in prey items, suggesting these elements may be excreted by this species. Mercury concentrations in dolphin tissues were, however, an order of magnitude higher than in prey items and could be considered potentially health threatening (max: 906 µg/kg dry wt.). Clarke et al. (2000) propose a risk assessment methodology for evaluating potential impacts associated with contaminated mud disposal in the marine environment.

According to Parsons (2002b) it is extremely likely that many areas populated by humpback dolphins are highly contaminated with butyltin. For example, humpback dolphins inhabit the waters of several coastal ports in Asia that host a large volume of shipping and, therefore, potential butyltin pollution, e.g., Shanghai, Bombay, Singapore and Hong Kong. However, next to nothing is known about levels or effects of BT contamination on these cetaceans and analysis of BT contamination in the tissues of humpback dolphins in areas of high shipping traffic should be a priority

To date, there has only been one assessment on the potential impacts of sewage pollution on humpback dolphins. This study took place in Hong Kong, a region which discharges over 2,000 million litres of sewage into its coastal waters every day. Bacteria can gain egress into the mammalian body by a variety of routes and Parsons (1997b) estimated that a Hong Kong humpback dolphin's minimum daily intake of sewage bacteria through ingesting contaminated seawater alone could be up to 70,500 faecal coliforms/day (Parsons, 1997b). To put this in context, a one-off ingestion rate of 200–300 coliforms is considered to be unacceptable for humans. The majority of humpback dolphin populations exist in the coastal or estuarine waters of developing nations, countries that would have little provision for sewage treatment, and for some populations the adjacent human population is substantial. Therefore, more studies should be conducted into the potential impacts of this type of pollution (Parsons, 2002b).

7. Remarks

Sousa sp. is listed in Appendices I&II of CITES. The species is categorized as "Data Deficient" by the IUCN. Evidence of migration across international boundaries was the reason for listing under Appendix II of CMS. *S. chinensis* is protected in Myanmar and Malaysia (Reyes, 1991).

Range States so far identified are Australia, Burma, Brunei, Indonesia, Malaysia, Myanmar, Papua New Guinea, People's Republic of China (including Taiwan and Hong Kong), Macau, the Philipines, Singapore, Thailand and Vietnam. Countries from within the range from which records have not been reported include Bangladesh, and Cambodia, but the species may be expected to occur there (Jefferson and Karczmarski, 2001).

According to Liu and Hills (1997) the habitat of *Sousa chinensis* has been disrupted in Hong Kong waters by major development projects, marine pollution and fishing and shipping activity. It is possible that the species will become extinct in Hong Kong waters by the beginning of the 21st century. The failure to address effectively the problems faced by the Chinese white dolphin may be attributed to the lack of an overall conservation strategy in Hong Kong, shortcomings in the territory's environmental impact assessment system and limited local scientific knowledge concerning the dolphin population.

More research on biology, taxonomy, stock identity and movements is needed. Assessment of ecological impact should be requested of development projects through the range. Compilation of Information on direct takes and incidental mortality should be encouraged. See also general recommendations on Southeast Asian stocks in Perrin et al. (1996) in Appendix 2.

Jefferson (2000) iterated detailed Specific Management Recommendations for Hong Kong that would also help to ensure effective conservation of the *Sousa* population elsewhere:

(1) A large-scale public awareness campaign should be launched to inform people of the need for environmental conservation.

(2) A major effort should be made to clean up local waters and otherwise improve water quality. Sources of toxic illegal substances, such as DDT, should be investigated and eliminated.

(3) Due to the likelihood that high levels of pathogenic bacteria would cause health problems for the dolphins, existing and future sewage outfalls in the dolphins' range should be upgraded or designed to include both primary (or secondary) chemical treatment and disinfection.

(4) To obtain reliable, quantitative information on bycatch rates and dolphin—fishery interactions, an onboard fishery observer program should be initiated, at least for the pair trawl fishery.

(5) A management strategy should be pursued with respect to mortality from incidental catches, vessel collisions, and other human-caused deaths. This should make use of the concept of Potential Biological Removal (PBR).

(6) Mitigation measures, such as monitored exclusion areas and the use of a bubble curtain to muffle potentially damaging piling noise levels, should be

required for development and construction projects that will occur within important habitat areas for the dolphin population.

(7) Additional dolphin habitat should be protected.

(8) The conservation and management of humpbacked dolphins (as well as finless porpoises) should be seen as an integral part of a multi-disciplinary coastal zone management (CZM) strategy.

Recommendations for Further Research (Jefferson, 2000):

(1) Line transect monitoring would allow for tracking of population trends with a high degree of statistical power.

(2) Programs involving vessel surveys of distribution and abundance and recovery of stranded animals, should be extended to other areas along the coast. Only by doing so, can the situation of the local population be put into the larger context.

(3) Recovery of stranded and salvaged carcasses should be strengthened, with particular emphasis on increasing access to fresh specimens. Additional emphasis should be placed on detailed pathological examination of fresh carcasses to determine mortality and morbidity factors. In order to determine empirically what effect different environmental pollutants are having on the animals, indices of health of specific individuals should be correlated with levels of various toxic contaminants.

(4) To obtain accurate data, representative of the population as a whole, organochlorine levels of live dolphins should be evaluated.

(5) Because knowledge of stock structure is such an important management issue, population discreteness should be examined further using molecular, morphometric, and other techniques. Collection of skin samples from biopsies would greatly facilitate this.

(6) We still have little information on the critical issue of life history parameters. Therefore, the reproductive biology and life history of the population should be further examined. In particular, parameters such as age and length at sexual maturity, length of stages in the female reproductive cycle, and reproductive mates should be studied.

(7) Due to the fact that there has been almost no research conducted on the acoustic behaviour of and noise disturbance factors for Indo-Pacific humpbacked dolphins, a study to characterize the predominant sounds made by the animals should be conducted. This should also include an evaluation of potential acoustic disturbance from human-caused sound sources in the dolphins' environment.

8. Sources

see *S. teuszii* (page 271)

5.60 Sousa plumbea (G. Cuvier, 1829)

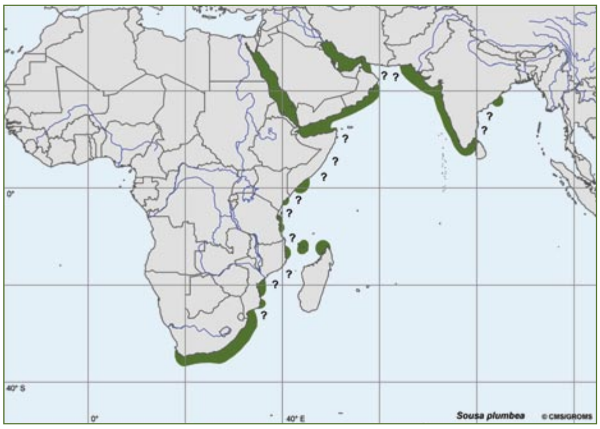
English: Indian humpback dolphin, plumbeous dolphin, speckled dolphin, freckled dolphin
German: Indischer Flußdelphin
Spanish: Delfín jorobado de la India
French: Dauphin des Indes

Drawing of Sousa plumbea © Wurtz-Artescienza.

1. Description

See *S. chinensis* (page 262).

For the purpose of this review, I have followed Rice (1998) who separates the Genus *Sousa* into three species. However, recent morphological studies, supported somewhat equivocally by genetic analyses, indicate that there is only one single, variable species for which the name *S. chinensis* has priority (Ross (2002). In a recent paper for the International Whaling Commission, Parsons (2002) provides a thorough review on the genus *Sousa*, but see also Jefferson and Karczmarski (2001).



Distribution of Souza plumbea: Coastal seas along the Western Indian Ocean, Red Sea, Northern Indian Ocean and Gulf of Bengal (mod. from Jefferson et al. 1993; Rice, 1998; Jefferson and Karczmarski, 2001; © CMS/GROMS).

2. Distribution

Souza plumbea ranges in coastal waters of the Indian Ocean from False Bay (18°30'E) in Cape Province north along the coast of eastern Africa, including Madagascar, to the Red Sea as far north as Gulf of Suez, the Arabian Sea, and the Persian Gulf, thence east along the coasts of southern Asia at least as far as Vishakhapatam on the western Bay of Bengal. It is vagrant in the Ganges River 250 km from the sea and has also strayed into the Mediterranean Sea via the man-made Suez Canal. The type locality is the Malabar Coast of India; includes *Sousa lentiginosa* (Gray, 1866) from Vishakhapatam, India (Rice, 1998).

3. Population size

Little information on population size is available. Saayman and Tayler (1979; in Ross et al. 1994) estimated the total population in the Plettenberg Bay area, South Africa, at about 25 animals.

Accurate population estimates for the Natal coast have not been made, but available data suggest a total of perhaps 200 animals, indicating that anti-shark nets can have a considerable impact on humpback dolphin populations (see below; Ross et al. 1994 and references therein; Jefferson and Karczmarski, 2001).

Karczmarski et al. (1999) found the minimum population size at Algoa Bay on the south Eastern Cape coast of South Africa to be about 466 dolphins. A census of

Indo-Pacific humpback dolphins living in the Bazaruto Archipelago in Mozambique between the mainland and the Bazaruto islands numbered 60 according to a 1992 survey.

Rough population estimates for the Indus delta were 500 animals (Ross et al. 1994 and refs. therein).

4. Biology and Behaviour

Habitat: Indian hump-backed dolphins prefer shallow nearshore or inshore waters. Off South Africa they are rarely found more than 1 km offshore or in waters more than 20 m in depth. In other areas they can be found within 5 km from shore. In many areas except some zones in South Africa these dolphins are truly coastal, entering estuaries and frequenting mangrove zones or the open sea in the vicinity of coasts and islands. Occasionally they may move into rivers (Reyes, 1991 and references therein).

Karczmarksi et al. (2000) examined environmental and behavioural determinants of the habitat use and preferences of Indo-Pacific humpback dolphins inhabiting the Algoa Bay region on the south Eastern Cape coast of South Africa. The dolphins inhabit a narrow strip of shallow, inshore waters of Algoa Bay and remain mostly within 400 m of the shore, in water less than 15 m deep, with no apparent preference for clear or turbid water. Water depth is probably the main factor limiting their inshore distribution, and the 25-m isobath seems to represent the critical depth. Within this confined, inshore distribution, dolphin activities concentrate in the vicinity of rocky reefs—their primary feeding grounds. Dolphin dependence on these shallow-water habitats is evident throughout the year and, consequently, the inshore shallow reefs are identified as the "key habitat" in Eastern Cape waters. This makes them particularly vulnerable to alteration or loss of this habitat.

Schooling: Humpback dolphins form small schools throughout their distribution, ranging from one to about 25 dolphins off South Africa and the northern Indian Ocean (Ross et al. 1994 and references therein). The detailed study of Saayman and Tayler (1979; In Ross et al. 1994) at Plettenberg Bay, South Africa showed that nearly 77 % of all groups contained less than 10 dolphins, and that larger groups consisted of various combinations of subgroups. Mean group size was 6.9 dolphins. Most single animals or pairs were adults, and immatures tended to associate with groups containing more than one adult. The authors stress the similarity between the highly flexible social organization of humpback dolphins and chimpanzees, suggesting that this may alter in response to variability in the availability and location of food resources.

Karczmarski (1999) investigated group dynamics of humpback dolphins inhabiting the Algoa Bay region on the south Eastern Cape coast of South Africa. Group size varied from three to 24 animals, with adults representing almost two-thirds of the group members.

Reproduction: Births occur predominantly in summer. Some females, however, may also cycle outside of the apparent summer breeding season, perhaps indicating a secondary winter season. Circumstantial evidence suggests a minimum of a 3-year calving interval. Maternal care lasts at least 3–4 years, but female-calf separation is seemingly not related to the female's next pregnancy (Karczmarski, 1999).

Food: The food reported for this species comprises sardines, mackerel, mullet and other near-shore fishes. Off southern Africa *S. plumbea* seems to feed on or close to reefs along rocky coastal areas in preference to areas with sandy bottoms (Reyes, 1991 and refs. therein; Ross et al. 1994 and refs. therein). Saayman and Tayler (1979 in Ross et al. 1994) observed a significant increase in time spent feeding during the rising tide by South African dolphins, suggesting that prey may be more available during this period.

All 503 prey items in the stomachs of 17 dolphins captured in shark nets off Natal, South Africa, were fish. Numerically, the major prey species were *Thryssa vitrirostris* (46.4 %), *Trickiurus lepturus* (9.2 %), *Pomadasys olivaceum* (8.6 %), *Otolithes ruber* (7.2 %), and *Diplodus sargus* (3.6 %). The remaining 24 % comprised a further 28 prey species. Nearly 61 % of all fish were littoral or estuarine species, and a further 25 % were demersal species primarily associated with reefs (Ross et al. 1994 and references therein).

5. Migration

Karczmarski (1999) performed mark-recapture analyses on photo-identification data for Indo-Pacific humpback dolphins inhabiting Algoa Bay. The rate of discovery of newly identified dolphins, distribution of sightings and frequency of resightings of known individuals indicate a high level of seasonal immigration of humpback dolphins into, and emigration from, the Algoa Bay region in summer. Consequently, humpback dolphins from

Algoa Bay appear to be part of a substantially larger population that uses a considerable length of the coastal zone. Although a few individuals may possibly be classified as 'resident', most dolphins were infrequent visitors in the Bay and seem to be transient. According to Karczmarski (2000) site fidelity is generally weak and is subject to seasonal migration, although female site fidelity seems to be related to reproductive stage. However another South African humpback dolphin population in Plettenberg Bay did not display any significant changes in abundance, although dolphins stayed within the Bay for significantly longer periods in the winter (May-July) than the spring (Aug-Sept), with animals being less restricted to the Bay in spring (Saayman and Tayler, 1979).

Movements of up to 120 km occur along both the Kwa-Zulu Natal and Eastern Cape coasts. In Maputo Bay, Mozambique, most Indo-Pacific Humpback dolphins are residents but transient individuals join resident groups temporarily (Jefferson and Karczmarski, 2001, and refs. therein).

Indian hump-backed dolphins are present year-round in the Indus delta. However, Lal Mohan (1988) reported on a peak in by-catches off the west coast of India between October and December, which accounted for 63.6% of the annual catch. Although these data should be treated with caution as the total number of by-caught dolphins included in the data set was low (n=11), they still represent the only data on possible seasonal changes in abundance for *Sousa chinensis plumbea* in the eastern Indian Ocean. Migration of the species along the coast is related to the movements of the fishes on which they feed. In other areas, movements are poorly understood (Reyes, 1991 and refs. therein).

6. Threats

Direct catch: Small numbers have been taken for food and oil In the Red Sea, Arabian Sea and Persian Gulf, and meat is consumed on the southwest coast of India (Calicut). This practice may still be in operation (Reyes, 1991 and refs. therein; Jefferson et al. 1993).

Incidental catch: The inshore distribution of these dolphins makes them very susceptible to many human activities in the coastal zone, particularly those relating to fishing. Fishing nets, including seine nets and especially gill nets set for sharks and other large fish, pose the greatest threat to humpback dolphins throughout much of their distribution. Entanglements in gillnets are reported from Djibouti, the Arabian Gulf, the Indus delta, and the south-west coast of India (Ross et al. 1994 and references therein), Pakistan, Sri Lanka, Iraq and Kuwait (Reyes, 1991, and refs. therein). Dolphins are also caught in shark nets set to protect bathing beaches along the Natal coast, South Africa. At least 67 humpback dolphins have been caught in the Natal nets between 1980 and 1989, or about 7–8 animals per year (Ross, 2002). Anti-shark nets are also a source of incidental mortality in South Africa (Reyes, 1991 and refs. therein).

Mass strandings: Between 23 August and 30 October 1986, over 500 dead dolphins were found on the western shores of the Persian Gulf, primarily those of Saudi Arabia and Qatar. At least 140 of these were humpback dolphins (Ross et al. 1994). The cause of this mortality, which included three other odontocete species, dugongs, sea turtles and fish, was not established conclusively.

Habitat degradation: Increased use of sensitive habitats also poses a threat to humpback populations. Pilleri and Pilleri (1979, in Ross et al. 1994) have pointed to the reduction in prime habitat for these dolphins in the Indus delta through construction of harbor facilities, drainage and destruction of mangroves, pollution and boat traffic which disturbs their habitat. Dolphins are no longer present in the lower reaches of rivers because of the construction of dams, silting of river mouths and increasing pollution. Organochlorine levels are the highest found in any marine mammal off the South African coast. These levels may affect the reproductive efficiency of males and be lethal to neonates of females pregnant for the first time (Reyes, 1991 and refs. therein).

Tourism: Karczmarski et al. (1997, 1998) reported that the behaviour of Indian humpback dolphins in Algoa Bay, South Africa was not affected by the presence of bathers or surfboats. However powerboats did cause changes in behaviour and when these vessels were present avoidance reactions were observed by the dolphins in 95.3 % of occasions (Karczmarski et al. 1998). The response to boat traffic involved the animals taking a long dive, changing their direction and swimming away perpendicular to the route of the boat (Karczmarski et al. 1997).

In Kizimkazi (Zanzibar) marine mammals were previously used as bait for sharks. However, in the mid

1990's the local fishermen realised that their touristic value far exceeded their value as shark bait. As many as 2,000 tourists visit the dolphin site at Kizimkaki per month. Dolphin-tourism is currently becoming a popular economic activity. Successful management of the dolphin-tourist trade will ensure continued visitors to the villages where dolphins are present and thus add income to these villages while contributing to management and conservation (Ali and Jiddavi, 1999).

7. Remarks

Indian hump-backed dolphins are exposed to most of the threats other coastal and estuarine dolphins face. Habitat encroachment is of particular concern, as is the incidental mortality which remains largely undocumented.

Karczmarski et al. (1998) suggest the establishment of protected areas where human impact could be limited or controlled. This seems to be the most effective conservation/management approach. Habitats critical for humpback dolphins in Eastern Cape waters (inshore rocky reefs) and the dolphin's core areas in the Algoa Bay region have been identified. It is recommended that a conservation and management zone (marine sanctuary) in the Algoa Bay region be established and a suitable site for it identified. Given adequate legislation and proper management, this area could be used for the development of ecotourism, including dolphin-watch operations, which would further stimulate interest in coastal conservation

National legislation protects the species, among other cetaceans, in India, Iran, Oman, South Africa, Sri Lanka and Sudan. No information is available from other countries in the range (Reyes, 1991).

Sousa sp. is listed in Appendix I&II of CITES.

Sousa plumbea is not listed by CMS although movements of the species in areas such as the Indus and Ganges Deltas, as well as along the East African coast, in the Red Sea and the Persian Gulf are likely to involve international boundaries. Inclusion in Appendix II of CMS should be considered, either for *S. plumbea* at the species level, or for *S. chinensis plumbea* at the subspecies level (see above).

Range States so far identified are Bahrain, Bangladesh, Comoros Islands, Djibouti, Egypt, Ethiopia, India, Iran, Iraq, Israel, Kenya, Kuwait, Madagascar, Martinique, Mozambique, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, South Africa, Sri Lanka, United Arab Emirates, United Republic of Tanzania and Yemen. Countries from within the range from which records have not been reported include Eritrea and Sudan, but the species may be expected to occur there (Jefferson and Karczmarski, 2001).

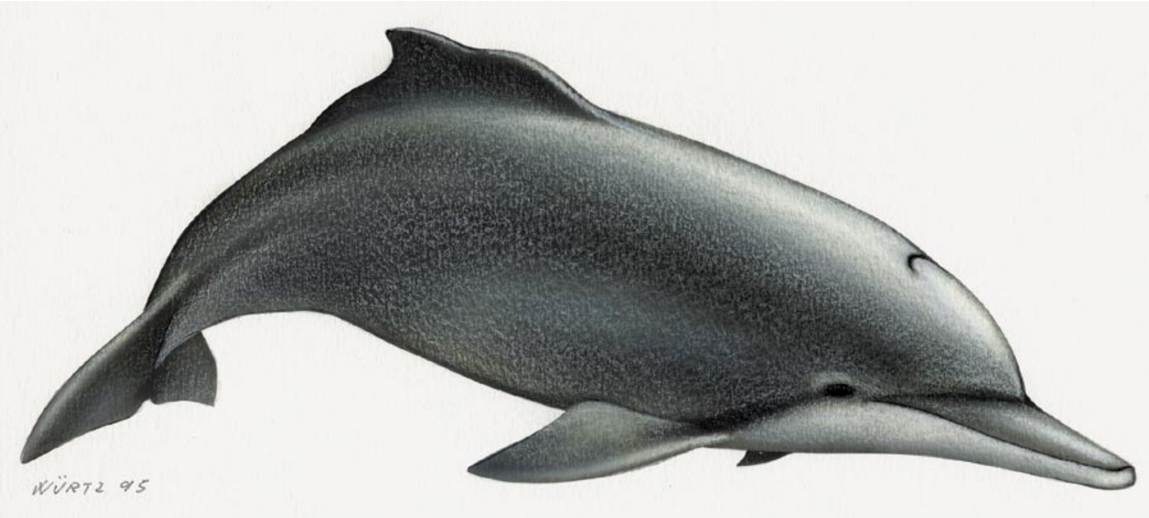
Research on biology, taxonomy, stock identity and movements is needed. Assessment of ecological impact should be requested of development projects through the range. Information on direct takes and incidental mortality must be compiled. See detailed recommendations for *S. chinensis* (see page 262).

8. Sources

see *S. teuszii* (page 271).

5.61 Sousa teuszii (Kükenthal, 1892)

English: Atlantic hump-backed dolphin, Cameroon dolphin
German: Kamerun-Flußdelphin
Spanish: Delfín jorobado del Atlántico
French: Dauphin du Cameroun



Drawing of Sousa teuszii © Wurtz-Artescienza.

1. Description

see *S. chinensis* (page 262).

Sousa taxonomy is based largely on small sample sizes for most populations. The several different nominal species are distinguished on several primary characters. Characters include tooth counts; number of vertebrae; form of the dorsal fin base and especially colour patterns (G. Ross, pers. comm.). G. Ross suggests that all *Sousa* from S. Africa to China and Australia are one species, and probably *S. teuszii* is also conspecific. However, "we will have a better idea when we can include more definitive genetic work" (G Ross, pers. comm.). For the purpose of this review, I followed Rice (1998) who separates the Genus *Sousa* into three species. This is supported by van Waerebeek et al. (2004).

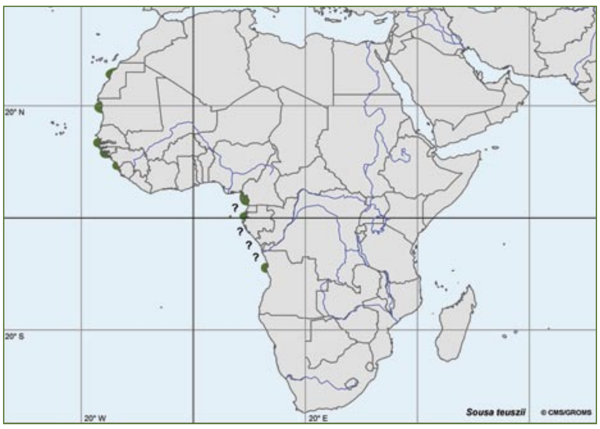
2. Distribution

Sousa teuszii ranges on the coast of West Africa from Dakhla Bay (23°54'N) in Western Sahara south to Tombua (15°47'S), southern Angola. A total of six contemporary management stocks are provisionally discerned: Dakhla Bay, Banc d'Arguin, Saloum-Niumi, Canal do Gêba-Bijagos, South Guinea and Angola. Two stocks are historical: Cameroon and Gabon Estuary (van Waerebeek et al. 2004; see map).

According to Carwardine (1995) this species seems to be particularly common in southern Senegal and north-western Mauritania.

3. Population size

Little information on population size is available. From north to south, the Dakhla Bay and the Banc d'Arguin stocks appear to be very small (van Waerebeek et al. 2004). Rough population estimates for the Saloum delta, Senegal were 100 animals (Ross et al. 1994, Reyes, 1991 and refs. therein). The high number of opportunistic sightings suggests that the still relatively undisturbed waters of Guinea-Bissau, enclosing extensive mangrove forest habitat, may support one of the largest known populations of *S. teuszii*: the Canal do Gêba-Bijagos stock. The status of the South Guinea, Cameroon and Gaboon Estuaries management stocks is unknown. The Angola stock is presumably very small (van Warebeek et al. 2004).



Distribution of Sousa teuszii: coastal waters of tropical West Africa (mod. from Waerebeek et al. 2004; © CMS/GROMS).

There are no further detailed population estimates for any of the regions where the species might exist (van Waerebeek et al. 2004).

4. Biology and Behaviour

Habitat: This species prefers coastal and estuarine waters less than 20 m deep and occurs in the surf zone on more open coasts. There are no reports of its presence in offshore waters. The preferred habitat is near sandbanks and mangrove areas, in turbid waters with temperatures ranging between 17°C and 28°C (Maigret, 1982, in Ross et al. 1994). It has been recorded up to 33 miles up the Saloum River and is known to enter Niger and Bandiala rivers, and possibly others, though rarely travels far upstream and usually remains within the tidal range (Carwardine, 1995).

Schooling: Humpback dolphins form small schools throughout their distribution, ranging from one to about 25 dolphins off West Africa (Ross et al. 1994 and refs. therein)

Reproduction: Breeding has been reported in March and April, but the season may be more protracted (Jefferson et al. 1993).

Food: Schooling fish e.g. mullet (Jefferson et al. 1993). Stomachs contained pomadasyid, clupeid and mugilid fish (Ross et al. 1994 and references therein). There is no evidence for herbivory as suggested by Kükenthal (1892) for *S. teuszii* (Jefferson et al. 1993).

Busnel (1973; in Ross, 1994) described a remarkable example of a symbiotic relationship between fishermen and groups of bottlenose dolphins on the Mauritanian coast around Cap Timiris, north of Nouakchott. The fishermen wait for migrating shoals of mullet to appear close to shore, and then apparently summon the dolphins by slapping sticks on the water surface. The dolphins effectively contain the mullet on their seaward edge while feeding, enabling the fishermen to deploy their nets around the fish more easily. Humpback dolphins also take part in the cooperative harvest, though perhaps fortuitously, since the method probably requires a larger number of dolphins than the usual humpback school size.

5. Migration

There are signs of a probable north-south migration for this species and there is a potential exchange of individuals between known population or subpopulation distribution centres (from north to south): Dakhla Bay, Banc d'Arguin, Langue de Barbarie, Sine Saloum delta, NW bank of the Gambia River outer estuary and Guinea-Bissau archipelago (van Waerebeek et al. 2000).

Atlantic hump-backed dolphins have been recorded in the Saloum Estuary from January to April with very few observations in subsequent months. However, catch data show that the species was taken north of the estuary from June to August (Reyes, 1991 and ref. therein). On the other hand Maigret (1982, in Reyes, 1991) recorded sightings of this species in the Banc d' Arguin between May and January, with a peak in August and September.

Off Senegal, humpback dolphins move onshore with the rising tide to feed in the mangrove channels of the Saloum delta, returning towards the sea with the ebb tide (Maigret, 1981 in Ross et al. 1994). According to Ross (2002), Senegalese animals may also shift northward in the summer.

6. Threats

Direct catch: A few Atlantic hump-backed dolphins have reportedly been taken along the range. No recent information is available, but direct catches still may occur (Reyes, 1991; van Waerebeek et al. 2000).

Incidental catch: There are reports of Incidental catches in beach seines and shark nets in Senegal. Past and present levels of these captures remain unknown (Reyes, 1991 and refs. therein). The most recent interaction in Senegal was recorded in November 1996 when three animals were found together, each with a piece of netting tied around the tailstock on a beach of Sangomar Island in the Saloum delta, probably an abandoned take. In Guinea-Bissau, a 190 cm male was by caught in a fishing trap at Canhabaque Island, Bijagós in March 1989 (van Waerebeek et al. 2000 and refs. therein).

Habitat degradation: In Senegal there has been a permanent reduction of mangrove areas for extension of rice culture and exploitation of forest, especially in the Fathala area. Excessive fishing of prey species may reduce food availability and increase the risk of incidental catch. Pollution may also be a source of habitat destruction, since the species inhabits areas with high population growth subject to agricultural and industrial development (Reyes, 1991 and refs. therein). The possible fracturing of the species' habitat range, resulting in reproductively isolated groups, due to coastal development should be monitored (van Waerebeek et al. 2000).

7. Remarks

The Atlantic hump-backed dolphin remains one of the less known small cetaceans, and since it inhabits coastal waters near populated areas it is likely that the level of threat is more extensive than reflected in this account.

No national legislation protecting this species has been identified, but several conservation areas may protect the habitat, in particular the national park of Banc d'Arguin in Mauritania and the Saloum National Park in Senegal (Reyes, 1991 and refs. therein; van Waerebeek, 2004).

Furthermore, the symbiotic relationship between fishermen on the Mauritanian coast between Noudadibou and Nouakchott and dolphins may result in protection of that population, since it is absolutely forbidden to harm the dolphins (Reyes, 1991 and refs. therein).

Sousa sp. is listed in Appendix I&II of CITES. The species is categorized as "Data Deficient" by the IUCN. Evidence of migration along the northwest coast of Africa were the reason for listing under Appendix II of CMS.

Confirmed Range States are Angola, Cameroon, Gabon, Guinea, Guinea-Bissau, Marocco, Mauritania, Senegal, and Sierra Leone (van Waerebeek et al. 2004).

More studies are needed to establish the actual range of the species, on the basis of which more range states between Guinea and Angola could be included. In addition research on biology, taxonomy, abundance, fishery interactions and human effects on habitat should be addressed to give a better idea of the status of the species (Reyes, 1991 and refs. therein; van Waerebeek et al. 2004). See detailed recommendations on *S. chinensis* (page 262).

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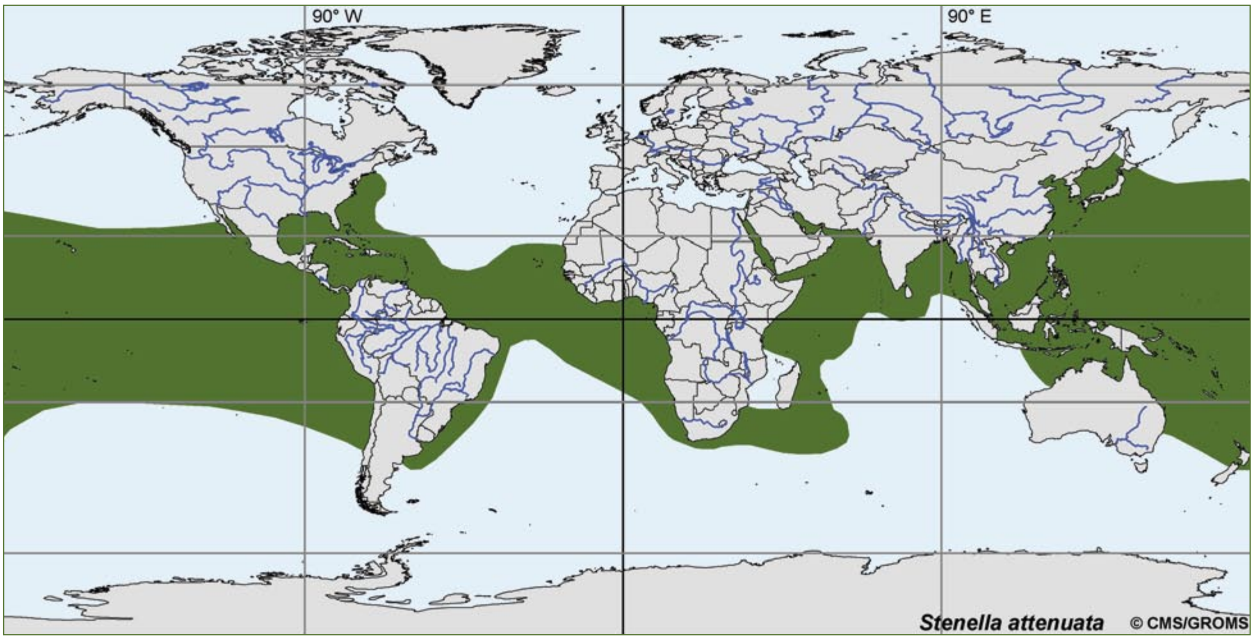
5.62 Stenella attenuata (Gray, 1846)

English: Pantropical spotted dolphin
German: Schlankdelphin
Spanish: Delfín manchado
French: Dauphin tacheté

Drawing of Stenella attenuata © Wurtz-Artescienza.

1. Description

Adult *S. attenuata* can be identified by their long beak, sharply demarcated from the melon, slender body, strongly falcate (curved backward) fin and spotted body. The newborn calf is unspotted. In adults, the ventral spots fuse and fade to a medium grey, and the dorsal light spots intensify, sometimes to the point of making the animal appear nearly white above. In adults, the tip of the beak is white. Details of coloration vary regionally. Adults range from 166 to 257 cm and weigh up to 119 kg. Males are on average slightly larger than females. As opposed to *S. frontalis*, with which it may easily be confounded, *S. attenuata* lacks a light spinal blaze and has a dorsoventral division of the peduncle. The dark ventral spots of *S. frontalis* are also lacking (Perrin, 2002).



Distribution of Stenella attenuata (mod. from Perrin and Hohn, 1994; © CMS/GROMS): Tropical and some warm temperate waters of the Atlantic, Pacific and Indian Oceans. It is found mainly where surface water temperatures are higher than 25°C (Carwardine, 1995).

2. Distribution

Stenella attenuata is distributed in tropical and warm temperate waters around the world, from roughly 30–40 °N to 20–40°S (Jefferson et al. 1993). It ranges north to Massachusetts, the islands of Cape Verde, the northern Red Sea, Persian Gulf, Arabian Sea, Bay of Bengal, South China Sea, East China Sea, Pacific coast of northern Honshu, the Hawaiian Islands, and Baja California Sur. Vagrant to Santa Cruz County in California, and Cold Bay on the Alaska Peninsula (Rice, 1998).

It ranges south to Uruguay, Saint Helena, Cape Province, Timor Sea, New South Wales, New Zealand, and about 35°S off Talca, Chile (Rice, 1998). In the Atlantic it is known from relatively few localities; it is broadly sympatric there with the Atlantic spotted dolphin *S. frontalis*, but it may not occur as far north as that species (Perrin and Hohn, 1994).

This species varies geographically in cranial and post-cranial measurements, and in body size and coloration, but in most of its range division into subspecies has not been attempted because too few specimens are available. However, in parts of the central and eastern Pacific, Perrin was able to distinguish Hawaiian, offshore, and coastal subspecies- the first two not yet named (the type locality of *S. attenuata* is unknown) (Rice, 1998):

S. a. subspecies B, the "Hawaiian spotted porpoise" of Perrin (1975). Inshore waters around the Hawaiian Islands.

S. a. subspecies A, the "Eastern Pacific offshore spotted porpoise" of Perrin (1975). Eastern tropical Pacific from about 14.5°W eastward to the immediate offshore waters between Baja California Sur and Colombia.

S. a. graffmani (Lönnberg, 1934). Inshore waters within about 25 km from land, between the Golfo de California and Colombia. This is the "Eastern Pacific coastal spotted porpoise" of Perrin (1975) and the "coastal spotted dolphin" of Dizon et al. (1994).

3. Population size

S. attenuata is among the most abundant dolphins in the eastern tropical Pacific (Jefferson et al. 1993). It ranges second in abundance in the deeper waters of the Gulf of Mexico, the eastern tropical Pacific and Sulu Sea, and sixth in the tropical Indian ocean (Perrin 2002). Perrin and Hohn (1994 and refs. therein) estimate the 1979 population levels at 1.7 million. The most recent estimates of absolute abundance in the eastern Pacific (Gerrodette, 1999) are 592,000 for the "north-eastern" stock, 710,000 for the "west/south" stock, and 73,000 for the "coastal" stock (*S. a. graffmani*). According to Jefferson and Schiro (1997), *Stenella attenuata* is the most common species of small cetacean in oceanic waters of the Gulf of Mexico. Jefferson (1996) counted 5,800 individuals in the north-western Gulf area.

The cetacean community of the Western Tropical Indian Ocean (WTIO) is similar to that of the eastern tropical Pacific (ETP) and the Gulf of Mexico (GM) in several respects. Regardless of ocean, three species comprised the majority of cetaceans in the community, *Stenella attenuata*, *S. longirostris*, and *S. coeruleoalba*, representing 62 % – 82 % of all individuals for all species. However, the rank order of abundance for these three species differs with ocean. Most notably, *S. attenuata* is abundant in the ETP and GM but much less common in the WTIO. Although habitat preferences for *S. attenuata* appear to overlap considerably with those of *S. longirostris* in the ETP, results suggest there may actually be significant differences between these two species. Detailed analysis of oceanographic correlates of distribution will be necessary in order to understand fully the habitat requirements of these pelagic dolphins, often the most conspicuous elements of tropical cetacean communities around the world (Balance and Pitman, 1998).

Dolar et al. (1997) surveyed marine mammal distribution and abundance in the southern part of the Sulu Sea and north-eastern Malaysian waters. Population size estimates for pantropical spotted dolphin were 3,500 individuals. For the Eastern Sulu Sea, Dolar (1999) estimated a total population size of 13,000.

4. Biology and Behaviour

Habitat: In the eastern Pacific the pantropical spotted dolphin is an inhabitant of the tropical, equatorial and southern subtropical water masses. The waters in which the animal occurs with greatest frequency are those underlain by a sharp thermocline at depths of less than 50 m and with surface temperatures over 25°C and salinities less than 34 parts per thousand. These conditions prevail year round in the region north of the Equator called the "Inner Tropical" waters of the eastern Pacific. Occurrence in this core habitat is correlated with apparent multi-species foraging and feeding behaviour. The species also occurs in closely similar waters south of the Equator that expand and contract greatly with season and year to year (Perrin and Hohn, 1994 and refs. therein).

In the Atlantic, *S. attenuata* is primarily a dolphin of the high seas and oceanic islands, but in the eastern Pacific a large-bodied race occurs along the coast from Mexico to Peru; it may feed on larger prey than does the oceanic form and may be an ecological counterpart of the large form of the endemic *S. frontalis* in Atlantic coastal waters (Perrin and Hohn, 1994 and refs. therein).

Schooling: A "school" (all of the animals seen at one time, or captured in one purse-seine set) may consist of from just a few dolphins to several thousand. Observations of schools captured in purse seines show that they are often formed of distinct subgroups containing cow-calf pairs, adult males, or juveniles (Perrin and Hohn, 1994 and refs. therein).

Spotted dolphins in the oceanic eastern tropical Pacific aggregate with yellowfin tuna, *Thunnus albacares*. Other participants in the aggregations include spinner dolphins (*S. longirostris*), skipjack tuna (*Katsuwonus petamis*), oceanic birds of several families, and less commonly other small cetaceans, sharks and billfish. The reason for these associations is not known but may have to do with foraging efficiency, protection from predators, orientation in the pelagic void, or some other factor or circumstance not yet understood. Tuna fishermen take advantage of the dolphin-tuna association in finding and catching tuna (Perrin and Hohn, 1994 and refs. therein). In the Western Tropical Indian Ocean (WTIO), Balance and Pitman (1998) recorded 26 mixed-species cetacean schools, 43 schools with which seabirds associated, and 17 schools associated with tuna. Notable among these were mixed aggregations of *Stenella attenuata*, *S. longirostris*, yellowfin tuna, and seabirds.

Food: The prey of the pantropical spotted dolphin is made up primarily of small epipelagic fish, squid and crustaceans, with some take of mesopelagic animals. Pregnant females may have feeding habits different from those of lactating females (Perrin and Hohn, 1994 and refs. therein).

Identified prey of *Stenella attenuata* include 56 species of fish and 36 species of cephalopods (Roberston and Chivers, 1997). The most frequently found fish were lanternfish (family Myctophidae) at 40 %, and the most frequently found cephalopods were trying squids (family Ommastrephidae) at 65 %. The dominance of these primarily mesopelagic prey species and a significantly higher stomach fullness index for stomachs collected during the morning hours suggest that pantropical spotted dolphins feed at night when many mesopelagic species migrate toward the surface. Significant differences in prey composition by season and geographic region indicate that pantropical spotted dolphins are flexible in their diet and may be opportunistic feeders. Comparison of the diets of pregnant and lactating female dolphins revealed that lactating females increase both the proportion of squid in their diet and the quantity of food consumed.

Baird et al. (2001) studied diving and nighttime behaviour of pantropical spotted dolphins near the islands of Maui and Lana'i, Hawai'i, in 1999. Suction-cup-attached time-depth recorder/VHF-radio tags were deployed on six dolphins for a total of 29 h. Rates of movements of tagged dolphins were substantially lower than reported in pelagic waters. Average diving depths and durations were shallower and shorter than reported for other similar-sized odontocetes but were similar to those reported in a study of pantropical spotted dolphins in the pelagic waters of the eastern tropical Pacific. Dives (defined as >5 m deep) at night were deeper (mean = 57.0 m, maximum depth 213 m) than during the day (mean = 12.8 m, maximum depth 122 m), and swim velocity also increased after dark. These results, together with the series of deep dives recorded immediately after sunset, also suggest that pantropical spotted dolphins around Hawai'i feed primarily at night on organisms associated with the deep-scattering layer as it rises up to the surface after dark.

5. Migration

Seasonal migrations have been observed for the population in the coastal waters of Japan. Here, spotted dolphins move north in summer, and probably concentrate at the northern boundary of the Kuroshiro current. In winter they move south, reaching a migration peak in late October and early November (Reyes, 1991, and ref. therein).

In the eastern tropical Pacific tagging experiments show that movement of pantropical spotted dolphins may generally be onshore in fall and winter and offshore in late spring and summer. The minimum distance travelled by the tagged animals ranged from 7 to 582 nautical miles (Reyes, 1991, and refs. therein). Offshore spotted dolphins may be found as close to the coast as 16 nautical miles, where they overlap with the coastal form (Reyes, 1991, and refs. therein).

Reilly (1990) studied large-scale patterns of dolphin distribution and oceanography from research-vessel surveys conducted in the pelagic eastern tropical Pacific during June to November 1982, 1986 and 1987. Substantial changes were observed in relation to previously reported winter distributions for spotted dolphin schools. These dolphin species were sighted in abundance west of 120°W along 10°N coincident with seasonal shoaling of a thermocline ridge. Highest-density areas for the different species were clearly separated spatially, and the thermocline depths surface temperatures of sighting localities were statistically different between spotted/spinner dolphin schools and common dolphin schools.

6. Threats

Direct catches: Only Japan takes large numbers of spotted dolphins for human consumption in drive and harpoon fisheries. The catch in 1982 was 3,799 and annual catches between 1994 and 1997 ranged from 23 to 449 (Perrin, 2002 and refs. therein). The drive fishery for spotted dolphins began in 1959 and is thought to have caused a slight decline in the minimum age attainment of sexual maturity in females. Pantropical spotted dolphins are also taken in hand-harpoon fisheries in the Philippines, Laccadive Islands and Indonesia and Sri Lankan gillnet and harpoon fisheries (e.g. Dolar et al. 1994). A former drive fishery at Malaita in the Solomon Islands took several hundred or thousands of spotted dolphins annually in the 1960s. Small numbers are taken in numerous small subsistence fisheries for dolphins and whales around the world, e.g. at St Vincent in the Lesser Antilles (Perrin and Hohn, 1994 and refs. therein).

Incidental catches: The tuna fishery in the eastern tropical Pacific targets the pantropical spotted dolphin to catch yellowfin and skipjack tuna that often swim below the herds. This ecological association of tuna and dolphins is not clearly understood (Gerrodette, 2002). Annual mortality of spotted dolphins in the late 1980s was in the tens of thousands. Takes of hundreds of thousands per year in the 1960s and 1970s reduced the northern offshore stock of *S. attenuata* to an unknown degree (Perrin and Hohn, 1994 and refs. therein).

According to Wade (1995) mortality estimates from the period with the greatest kill of dolphins, 1959-72, are important for estimates of the level of depletion of these stocks from their unexploited population sizes. A redefinition of the geographical boundaries of offshore stocks of *Stenella attenuata* makes it necessary to estimate the annual kill for these newly defined stocks for 1959-72. Wade (1995) estimated that 4.9 million dolphins were killed by the purse-seine fishery over that fourteen-year period (1959-72), an average of 347,082 per year. Nearly all of the fisheries kill of pantropical spotted dolphins was of the north-eastern stock, totalling 3.0 million (211,612 per year). Estimates of kill for the eastern stock of spinner dolphins were similar to previous estimates, totalling 1.3 million (91,739 per year).

In the early 1990's, the kill declined to around 15,000 due to improved rescue techniques (Perrin and Hohn, 1994 and refs. therein). Gosliner (1999) summarises, that as the US brought dolphin mortality by its fishermen under control in the 1980's, the numbers of dolphins being killed again skyrocketed as a shrinking US fleet was replaced by those from Mexico, Venezuela, and other nations. Through the use of trade sanctions, and ultimately international co-operation, dolphin mortality has recently (1997) been reduced to levels generally believed to be biologically insignificant (0 dolphins in US fishery, ca. 3,000 in non-US fisheries).

Although tuna and dolphins are still herded and captured together in the net, the crew attempt to release the dolphins by a procedure called "backdown," while utilising various dolphin safety gear. Though a great majority of the dolphins are released unharmed, some die during the fishing operation. The Tuna-Dolphin Program of the Inter-American Tropical Tuna Commission (IATTC) is charged with monitoring this incidental mortality, studying its causes, and encouraging fishermen to adopt fishing techniques which minimise it. Since 1986, dolphin mortality has been reduced by 97%. Analyses of observer data show that many factors cause dolphin mortality, such as fishing areas; dolphin species and herd sizes; environmental factors; gear malfunctions; and crew motivation, skill, and decision-making. Given this, it is clear that there can be no simple solution. A combination of major and minor technological developments, training in their use, better decision-making skills, and constant pressure to improve performance are the basis of the current success (Bratten and Hall, 1997).

Nevertheless, the use of dolphins to locate and catch tuna will remain controversial as long as any of these cetaceans are killed or injured in the process (Gosliner, 1999). Gerrrodette (2002) states that by 1999, there was no clear indication of a recovery for northeastern offshore spotted dolphins. Several factors could be responsible for this:

- cryptic effects of repeated chase and encirclement on survival and/or reproduction (internal injuries, stress, hyperthermia), separation of nursing calves from their mothers during the fishing process. Indeed, Archer et al. (2001) report a calf deficit in the number of lactating spotted dolphin females being killed between 1973 and 1990. These unobserved deaths of nursing calves due to separation from their mothers during fishing indicate that the reported dolphin kill fails to measure the full impact of purse-seine fishing on spotted dolphin populations.

- unobserved or observed but unreported adult mortality,

- effects due to breakup of dolphin schools (increased predation, social disruption),

- ecological effects due to removing tuna from the tuna-dolphin association, and

- ecosystem or environmental changes.

The intense fishing pressure on tuna supports these hypotheses: Schools of 1,000 or more dolphins are estimated to be set on approximately once a week each on average, but such schools are estimated to represent just under one tenth of the animals in the northeastern offshore stock. Schools set on most often by tuna purse-seiners, containing from about 250 to 500 dolphins, are estimated to be set on between two and eight times each per year and are estimated to include approximately one third of the stock. An estimated one half of the stock occurs in schools smaller than 250 animals; schools of this size are estimated to be set on less than twice per year each (Perkins and Edwards, 1999).

Yang et al. (1999) also report incidental mortalities from chinese fisheries and Dolar et al. (1997) found that 4 of the 7 fishing villages surveyed in the Philippines reported directed and/or incidental spotted dolphin takes.

Killing: Dolphins and small whales of several species, including *S. attenuata*, interfere in hook-and-line fisheries for squid and yellowtail in the Iki Island region of Japan. Bounties have been paid to fishermen for dolphins killed since 1957. During the period 1976-1982 a total of 538 spotted dolphins were killed. The effect of these takes on the population is not known (Perrin and Hohn, 1994 and refs. therein).

Pollution: André (1988, in Perrin and Hohn, 1994) and André et al. (1990a, 1990b) reported levels, somatic distribution, and age-related changes in levels of Hg, Cd, Cr, Cu, Mn, Ni, Se, Zn, sDDT and PCBs in pantropical spotted dolphins from the eastern Pacific. Calmet et at. (1992) reported levels of radioactive isotopes of Pb, Cs and K in the same specimens. Cockcroft et at. (1991) reported levels of seven organochlorines in four specimens from Natal (both in Perrin and Hohn, 1994). Relatively high concentrations of DOT and PCBs have been found in some dolphin species in the eastern tropical Pacific and the western North Pacific. For example O'Shea et al. (1980, in Reyes, 1991) reported that DOT and PCB concentrations were higher in striped dolphins from the eastern tropical Pacific than in those from Japanese waters. The source of contamination in these tropical waters is unknown.

7. Remarks

According to Gosliner (1999) dolphin mortality in the eastern tropical Pacific tuna fishery is no longer considered by most marine mammal scientists to be biologically significant. "It may be that we are finally approaching the point at which further reductions in dolphin mortality using traditional fishing techniques are unlikely. Currently, about 88% of sets on dolphins result in no incidental mortality. Further reductions may be achievable only through new technical advances or a shift toward dolphin-safe fishing methods, raising other bycatch concerns". However, the question of whether any level of dolphin mortality incidental to tuna fishing is at all acceptable will no doubt continue to stir controversy (Gosliner, 1999). Furthermore, since some stocks like the north eastern offshore spotted dolphin stock show no sign of recovery (Gerrodette, 2002), there is still matter for concern (see above).

The eastern tropical Pacific and south-eastern Asian populations of *Stenella attenuata* are listed in Appendix II of CMS. The species is listed as "Lower Risk, conservation dependent" by the IUCN.

Range States include Colombia, Costa Rica, Ecuador, El Salvador, France (Clipperton Islands), Guatemala, Honduras, Mexico, the Netherlands, Nicaragua, Panama, Peru, Spain, the United States and Vanuatu, as well as all other maritime nations with tropical or semi-tropical waters.

Co-operative research is needed in order to continue with the reduction of incidental mortality, and to identify potential sources of habitat degradation, such as pollution. The species also occurs in Southern South America, so please see Hucke-Gaete (2000) for further recommendations in Appendix 1. General recommendations on Southeast Asian stocks can be found in Perrin et al. (1996) in Appendix 2.

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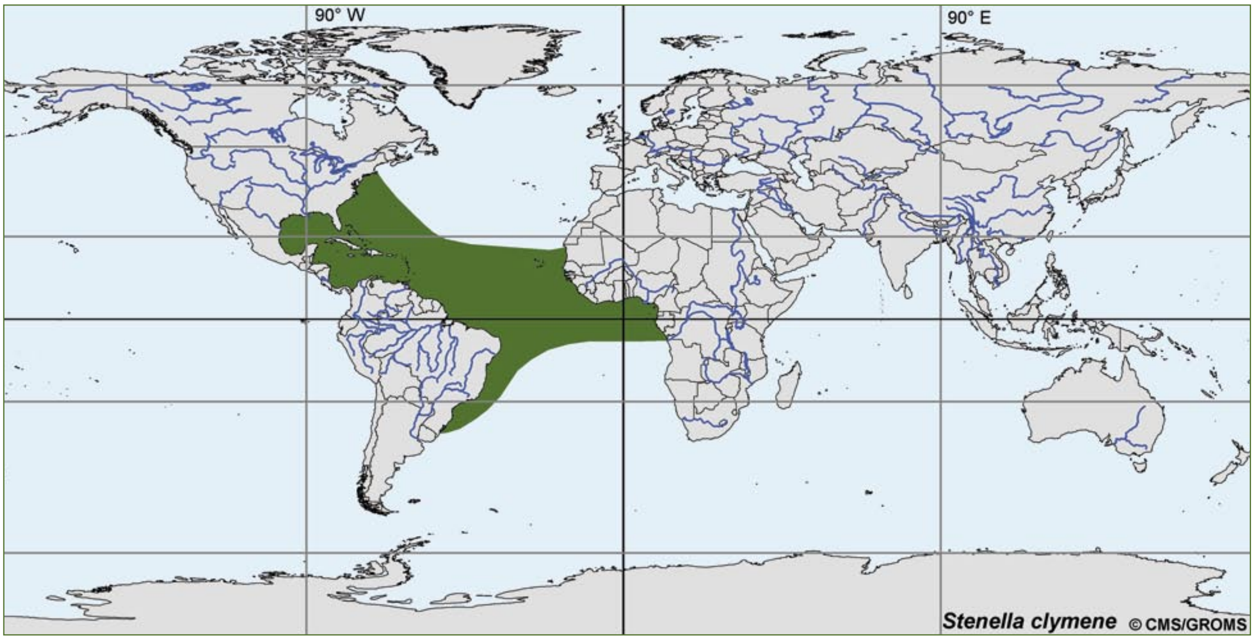
5.63 Stenella clymene (Gray, 1850)

English: Clymene dolphin
German: Clymene-Delphin
Spanish: Delfín clymene
French: Dauphin de Clymène

Drawing of Stenella clymene ©Wurtz-Artescienza.

1. Description

The Clymene dolphin is small but rather stocky and has a moderately long beak. The dorsal fin is tall and nearly triangular to slightly falcate and flippers and flukes resemble those of other members of the genera *Delphinus* or *Stenella*. The coloration is tripartite: the belly is white, the flanks are light grey and the cape is dark grey. There is a dark grey line running down the length of the top of the beak, but the most distinctive feature is a black "moustache" marking of variable extent at the top of the beak. With this exception, most of this species' external characters are very similar to those of the spinner dolphin. Body size reaches between 170–190 cm in females and 176–197 cm in males and maximum body mass recorded was 80 kg (Jefferson, 2002).



Distribution of Stenella clymene (mod. from Fertl et al. 2003; © CMS/GROMS): the species prefers the tropical, subtropical and occasionally the warm temperate waters of the Atlantic Ocean (see text above).

2. Distribution

The Clymene dolphin (*Stenella clymene*) is found in tropical and warm temperate waters of both the North and South Atlantic Oceans (Fertl et al. 2003). The northernmost record is from New Jersey and the southernmost from southern Brazil. It can be expected to occur along the eastern seaboard of the United States, throughout the Gulf of Mexico and Caribbean, along the north-eastern coast of South America, throughout the Equatorial Atlantic and along the entire tropical coast of West Africa (Perrin and Mead, 1994).

3. Population size

The scarcity of records of this species indicates that it may not be very abundant, at least in coastal waters. Considering the difficulty of distinguishing it from similarly marked species at sea, however, it may not be as rare as it would seem to be (Perrin and Mead, 1994). Based on capture records, *S. clymene* appears to be the most common cetacean in Ghana's coastal waters, but no individual stocks have been distinguished on the coasts of West Africa (van Waerebeek et al. 2000 and refs. therein). However, new West African specimens of *S. clymene* are evidence that the present unequal distribution of this species in the western and eastern parts of the tropical North Atlantic could be an artefact of poor sampling in African waters (Robineau et al. 1994).

Jefferson (1996) in a survey conducted in the northwestern Gulf of Mexico from 1992 to 1993 estimated the local population of *S. clymene* at about 2,300 individuals.

4. Biology and Behaviour

Very little is known of the clymene dolphin's natural history.

Schooling: Schools tend to be much smaller than those of spinner dolphins (generally less than 50 animals; Jefferson et al. 1993). Perrin and Mead (1994) report that schools of this species may be segregated by sex and age; three mass strandings in Florida were of two females with calves, three adult males, and six adult males. Of 47 specimens from a mass stranding in Louisiana in 1985, 43 were males (164–197 cm), two were females (155 and 168 cm, probably immature) and two were of unknown sex.

Watkins and Moore (1982, in Perrin and Mead, 1994) observed groups of 1–10 animals around St Vincent in the Caribbean. The clymene dolphins were swimming in close association with schools of spinner dolphins but remained clustered together and did not approach the vessel as closely as the spinners did. Three groups of clymene dolphins seen off the US coast consisted of three, eight and 15 animals. A school off West Africa consisted of approximately 50 dolphins. Schools of this species have also been seen in the company of common dolphins (*Delphinus delphis*) off West Africa (Perrin and Mead, 1994, and refs. therein).

Food: Clymene dolphins have been observed at sea only in deep water (250-5,000m or deeper). They may be night feeders on small fish and squids. The stomach of one stranded specimen contained one pair of small squid beaks (unidentified) and over 800 very small otoliths of fishes of the families Myctophidae, Argentinidae and Bregmacerotidae. Most of the species represented are mesopelagic but known to reach the surface at night during the course of vertical migrations. One myctophid (*Lampanyctus* sp.) usually does not occur in surface waters even at night (Perrin and Mead, 1994, and refs. therein). Fertl et al. (1997) report on Clymene dolphins feeding during the daytime in a co-ordinated manner on schooling fish in the Gulf of Mexico in water 1,243 m deep.

5. Migration

no entries.

6. Threats

Clymene dolphins are taken by harpoon in small numbers in a subsistence fishery at St Vincent in the Lesser Antilles. They are captured incidentally in gillnets in Venezuelan waters and utilised for longline shark bait and for human consumption (Perrin and Mead, 1994 and refs. therein). Contaminant levels have not been recorded. They may be one of the species taken in tuna purse seines in the eastern tropical Atlantic (Jefferson et al. 1993) and have been recorded from by-catches in Brazilian fisheries (Zerbini and Kotas, 1998).

7. Remarks

The Clymene dolphin listed as "Data Deficient" by the IUCN. The species is not listed by CMS.
Range states include the US, Mexico, Belize, Honduras, Nicaragua, Coasta Rica, Panama, Colombia, Venezuela, Guyana, Surinam, French-Guyana, Brasil, Cuba, Bahamas, Dominican Rep., Haiti, Mauretania, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Cote D'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroun, and Gabun.

The species is poorly known with respect to biology, life history, distribution and migratory habits. Further research on all aspects of its biology is needed. However, sightings at sea suggest a wide home-range, and individuals or groups thus may cross many international boundaries, especially in the Carribbean. Therefore, inclusion into appendix II of CMS is recommended. See further recommendations in Hucke-Gaete (2000) in Appendix 1.

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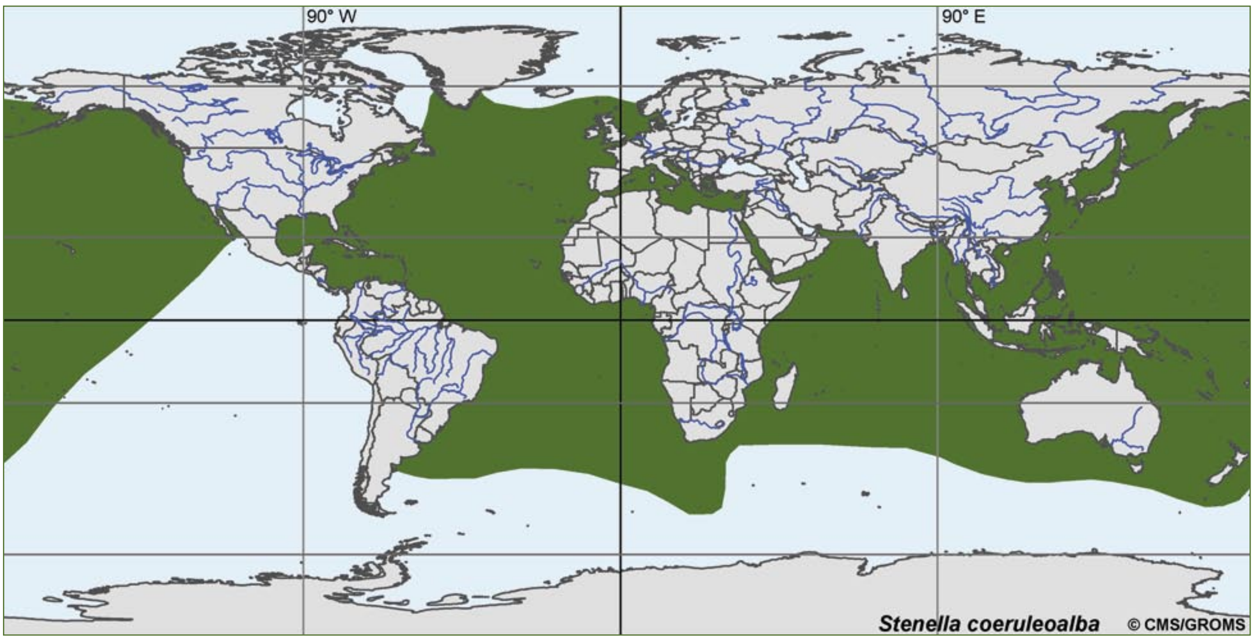
5.64 Stenella coeruleoalba (Meyen, 1833)

English: Striped dolphin, blue-white dolphin
German: Blauweißer Delphin
Spanish: Delfín listado
French: Dauphin bleu et blanc, dauphin rayé

Drawing of Stenella coeruleoalba © Wurtz-Artescienza.

1. Description

The trivial name "*coeruleoalba*" refers to the diagnostic pattern of blue and white stripes and blazes along the lateral and dorsal sides of the body of these dolphins. The dorsal cape is muted blue or blueish-grey, usually invaded by a white to light grey spinal blaze. The sides are darker than the belly. Striped dolphins have a long beak, well demarcated from the melon and falcate dorsal fin. In the field, they are most likely confused with common dolphins (*Delphinus delphis*) and other similar-sized species, but can easily be distinguished by their robust body and coloration. The longest recorded specimen was 2.56 m and the maximum weight recorded was 156 kg. Mean body length in the western Pacific is 2.4 m for males and 2.2 m for females (Archer, 2002).



Distribution of S. coeruleoalba (mod. from Archer and Perrin, 1999 and Perrin et al. 1994; © CMS/GROMS): warm temperate, subtropical, and tropical waters around the world.

Striped dolphins show only moderate geographical variation in skeletal morphometrics, and little if any geographical variation in pigmentation pattern. However, several authors found slight but significant differences in body size between local populations in the eastern North Atlantic, the north-western Mediterranean, and the south-western Mediterranean (Rice, 1998). Calzada and Aguiar (1995) studied the variation in maximum body size of striped dolphins, in various areas of the Mediterranean Sea. Animals inhabiting the southern part of the Mediterranean are larger than those inhabiting the northern fringe. The southern fringe is characterised by stronger seasonality and lower density of dolphins, both factors likely to favour larger maximum individual body sizes in a population. The variation observed may reflect population stratification leading to a degree of genetic isolation within the western Mediterranean Sea. MtDNA differentiation also suggests that NE-Atlantic striped dolphins form a separate population from the Mediterranean population (Garcia-Martinez et al. 1999).

2. Distribution

The striped dolphin is distributed world-wide in tropical and temperate waters. It ranges north in the Atlantic to Newfoundland, southern Greenland, Iceland, the Faroes, and Denmark; in the Mediterranean Sea; and in the Pacific to the Sea of Japan, Hokkaido, about 40°N across the western and central Pacific, and British Columbia (Canada). The southern limit of its range is Buenos Aires in Argentina, Cape Province, Western Australia, New Zealand, and Peru (Archer and Perrin, 1999; Rice, 1998; van Waerebeek et al. 1998; Baird et al. 1994).

As for the other tropical dolphins, its known range is likely to expand greatly as knowledge accumulates about the cetacean faunas of South America, Africa and tropical Asia. Although Perrin et al (1994) state that it is not a common inhabitant of cold boreal waters as previously claimed, there are coldwater records, e.g. from Greenland and the Faroe Islands, and Syvertsen et al. (1999) report sightings/strandings from the Norwegian coast. Vagrants have even been recorded from Komandorskiye Ostrova (Rice, 1998). However, in the south van Waerebeek et al. (2000) did not report new sightings or strandings from West Africa. The transoceanic distribution shown in the map is likely, based on oceanographic conditions.

3. Population size

Würsig et al. (1998) assessed cetacean responses to survey ships and aircraft and found that *S. coeruleoalba* moved to avoid the ships in 33 % of sightings. Their data indicate that density estimates for this species may tend to be biased downwards.

Based on sighting data in 1983–91, the total current striped dolphin population in Japanese waters is estimated at 821,000 with a standard error of 182,000 although questions of stock identity remain. Two concentrations of striped dolphin In the western North Pacific were identified. The first, estimated to comprise about 7,000 animals, was found between 20° and 30°N. The second, a large concentration of around 350,000 animals was located between 30° and 40°N. Relatively few striped dolphins were present in the nearshore waters off Japan, with an approximate population of 2,300 individuals (Perrin et al. 1994, and refs. therein).

In the eastern tropical Pacific, "relative" population estimates from annual survey cruises in 1986-90 range from 635,000 to 2,251,300 (Perrin et al. 1994, and refs. therein). Barlow (1995) estimated the abundance of *Stenella coeruleoalba* in California waters at 12,300 individuals between the coast and approximately 555 km offshore. Balance and Pitman (1998) found that *S. coeroleoalba* was the second most important species sighted in the Western Tropical Indian Ocean (14 % of all cetaceans) compared to the Eastern Tropical Pacific (33 %) and Gulf of Mexico (10 %).

Goujon (1996) conducted a sighting survey in 1993 and estimated population sizes of 74,000 striped dolphins in the fishing grounds of the albacore tuna driftnet fishery in the Bay of Biscay. In the western Mediterranean, it is the most common cetacean. The post-epizootic western Mediterranean population was estimated at 225,000 individuals. It was the most abundant species (43.5 %) in recent surveys of the central Mediterranean (Perrin et al. 1994, Reyes, 1991 and refs. therein).

In the regions of Valencia and Murcia (Spain) in the western Mediterranean the absolute density estimated was 0.416 individuals/km^2 and total abundance was 12,010 individuals (Gomez de Segura et al. 2003). Mean relative density in the whole area was 0.43 individuals/nm. A very high dolphin density area was found in the north of the Ibiza channel with a highest relative density of 9.2 individuals/nm. There were no seasonal changes in either the absolute density or in the distribution of this species in the area.

4. Biology and Behaviour

Habitat: Striped dolphins are basically pelagic, traveling In large groups of several hundreds and even thousands of individuals (Reyes, 1991). For the Western Pacific, Toshio (1999) reports that in summer striped dolphins are found in three geographical aggregations in the Pacific waters off Japan, between 20 and 42 °N. Occurrence is seasonal in the northern part of the range. They are uncommon in the Sea of Japan, East China Sea and Ryukyuan waters.

In the eastern Pacific, the distribution of striped dolphins tends to be complementary to that of the more strictly tropical *S. longirostris* and *S. attenuata*. Although there is great overlap, striped dolphins tend to be more frequent in areas where spinner and spotted dolphins are less frequent. They prefer areas with large seasonal changes in surface temperature and thermocline depth and with seasonal upwelling. Reilly (1990, in Perrin et al. 1994) found that year-round spatial separation in mean habitat features is maintained between the species, with striped dolphins intermediate between common and spinner/spotted dolphins in their oceanographic preferences.

Off South Africa, the species is oceanic, occurring beyond the continental shelf over depths of over 1,000 m, and its distribution is correlated with the warm Agulhas Current.

In the eastern North Atlantic, it is found in deep water (greater than 1,000 m) past the continental slope (Perrin et al. 1994 and refs. therein).

In western North Atlantic waters striped dolphins seem to be confined to the Gulf Stream or the waters off the continental slope (Davis et al. 1998).

In the Strait of Gibraltar, it is found in waters of 600 m or more depth (Hashmi, 1990).

Information from the Mediterranean shows that these dolphins way be found at waters deeper than 100 m (Reyes, 1991). According to Bourreau and Gannier (2003) striped dolphins in the Mediterranean are rather pelagic, mean water depths in sighting areas being 1,760 m.

Griffin (1997) reports that sighting rates of *Stenella coeruleoalba* increased with decreasing copepod density and increasing copepod diversity. Zooplankton community structure was found useful in understanding oceanographic characteristics of the habitat of odontocete species.

Schooling: Schools are of varying size and composition. Of 45 schools examined from off the coast of Japan, most (86%) contained fewer than 500 individuals. The mean school size was 101 animals. Schools moving south with the retreating front of the Kuroshio Current are larger than those moving north earlier in the year. Schools in the eastern North Atlantic more commonly have 10–30 individuals and rarely reach the hundreds. In the western Pacific, three major types of schools are recognised: juvenile, adult and mixed, the latter being divided into breeding and non-breeding schools. Juvenile schools may migrate closer to the coast than adult and mixed schools. Calves remain in adult schools until 1 or 2 years after weaning and then leave to join juvenile schools (Perrin et al. 1994 and refs. therein).

Food: Cephalopods dominated in the stomach contents of stranded striped dolphins on the Mediterranean coasts of France, Spain, and Italy, while myctophid fishes predominated in specimens from Japan and South Africa. Blanco et al. (1995) found that the cephalopods *Albraliopsis pfefferi*, *Onychoteuthis banksii*, *Todarodes sagittatus* and *Brachioteuthis riisei* were dominant in stomach samples from the western Mediterranean.

Feeding depth may extend to below 200 m and down to 700 m (Archer, 2002); 75–80% of the prey in the Japanese and South African material had organs of luminescence. Individual fish in the stomachs of the animals captured off Japan ranged in length from 60 to 300 mm (Perrin et al. 1994 and refs. therein; Santos et al. 2001a, 2001b).

Spitz et al. (2003) found that the diet of top predators varies according to food availability both in terms of quantity and composition. They analysed the contents of 23 stomachs from striped dolphins stranded on the coast of the Bay of Biscay, France between 1999 and 2002. Results were compared to similar samples analysed during the early 1980's. Observed trends were linked to biomass indices provided by groundfish surveys carried out by Ifremer on the eastern continental shelf of the Bay of Biscay. The most striking result was the opposite temporal trend of two fish species: *Gadiculus argenteus* and *Atherina presbyter*. The first species was not found in stomach contents from 1999 to 2002, whereas it was the second most abundant species in the early 1980's (28 % by number and 14 % by mass). The second species was most prominent in the diet of *S. coeruleoalba* between 1999 and 2002, representing 16 % by number and 17 % by mass, compared with 8 % and 4 % respectively in the 1980's. These changes agree with the trends observed in the groundfish survey biomass indices. The biomass of *G. argenteus* has been decreasing since 1992 and has been in very low abundance since 1997. Its spatial distribution has also reduced during the same period. By contrast, the biomass of *A. presbyter* recently increased (notably in 1995, 1998 and 1999) with a threefold increase in its occurrence in groundfish survey trawls since 1994. In summary, the diet of the striped dolphin reflects changes in the relative abundance of these two fish species according to groundfish survey trawls.

5. Migration

While in some regions (e.g. portions of the US east coast) the striped dolphin is encountered in all seasons, in other areas it appears to be associated with the fronts of warm oceanic currents that move seasonally and produce sporadic warm-water intrusions and meanders. In Japanese waters, the species is associated with the northern boundary of the warm Kuroshio Current, which extends up to 46°N in the summer and retreats to 33°N in the winter. It appears earlier in the season than *Stenella attenuata*, consistent with the hypothesis that the latter is the more tropical (Perrin et al. 1994 and refs. therein). Striped Dolphins approach the coast in September and October, and move southward along the coast, apparently dispersing into the East China Sea for the winter. In April they return along roughly the same route, but further offshore. Eventually they leave the coast to summer in the pelagic North Pacific. Segregation by age is observed (Reyes, 1991).

Seasonal movements may also occur in the Mediterranean. The dolphins move towards the northern part of the basin as the sea surface temperatures in the southern part increase. Sighting data also suggest seasonal movements of this species in the eastern tropical Pacific (Perrin et al. 1994; Reyes, 1991 and refs. therein).

Gannier (1999) investigated movements in the Ligurian Sea to describe the distribution shift off the French Riviera. Night acoustic results show the presence and intense feeding activity of striped dolphins close to the shelf break. Day distribution shows a marked preference for the open sea. In near-shore waters the relative abundance index of 2 dolphins per km in the morning falls to a minimum of 0.25 dolphins per km during the afternoon and then recovers to an evening level of 0.98 dolphins per km. The distribution shift is supported by the description of an average movement pattern computed from 146 records: morning offshore and evening inshore movements are clearly shown. This study presents the scheme of a horizontal diel migration cycle, consistent with the nocturnal feeding of dolphins close to the shelf, and a diurnal offshore-inshore movement, whose motivation is not precisely known.

6. Threats

Direct catch: The largest direct catches have been taken in Japanese waters, in drive and hand-harpoon fisheries at several locations that date back to at least the Meiji period (1868-1912). The catches were voluntarily reduced beginning in 1981 and have since varied between 358 (in 1987) and 4,883 (1981), averaging 2,830 during the period 1981-89. Between 1989–1993, the average catch has dropped to 1,028. Toshio (1999) reports that Japanese multispecies dolphin fisheries now receive an annual quota of 725. Fragmented information on morphology, life history, pollutant levels and genetics suggests that the striped dolphins taken by Japanese fisheries are from more than one population, with varying proportions among fisheries and perhaps over time.

Striped dolphins were also taken in the former drive fishery at Malaita in the Solomon Islands and in the harpoon fishery for small cetaceans at St Vincent. Other such small indigenous fisheries may exist elsewhere. Small numbers were taken by French and Spanish fishermen for human consumption in the Mediterranean (Perrin et al. 1994 and refs. therein; Jefferson et al. 1993).

In the Northeast Atlantic, striped and common dolphins were harpooned to supply food for consumption on board or to scare them away from tuna trolling lines. It is difficult to ascertain the number of dolphins taken in this way, but it has been estimated in the thousands (Reyes, 1991).

Incidental catch: Incidental catches are known to occur in gill nets in the north-eastern Indian Ocean, in tuna purse seines in the eastern tropical Pacific, in fisheries in the north-eastern Atlantic, in drift nets, purse seines and other gear in the Mediterranean, in various gear off the coast of Japan, in drift gill nets in the North Pacific, and probably occur in similar fisheries in tropical and warm-temperate waters around the world. Although rare, striped dolphins have also been caught in shark nets in Natal and South Africa (Perrin et al. 1994 and refs. therein).

A driftnet fishery for swordfish in the waters surrounding the Italian Peninsula was reported to have caught 68 striped dolphins among several other cetaceans in the period 1986–1988. These are considered underestimates of the total catch because the fishermen do not report all of the catches and because the area surveyed to document the catch was small relative to the total extent of the fishery. Some are taken by pelagic purse seines, but fishermen may allow the animals to escape (Reyes, 1991 and refs. therein).

Silvani et al. (1999) investigated by-catch rates in the Spanish driftnet fishery operating since 1994 on the Mediterranean side of Gibraltar Strait. The by-catch rate of dolphins (3 species in roughly similar proportions, including *S. coerueoalba*) was 0.1 individuals per km of net set. The total catch of dolphins was estimated at 366 animals for the 1993 fishing season and 289 for that of 1994. If these figures are added to the undetermined catches of dolphins by the Italian and Moroccan driftnet fleets also operating in the region, it is possible that these catches are not sustainable. Variation in sighting and stranding frequency suggests that striped dolphins may have increased in numbers in recent decades. However, this progressive increase may have run parallel to a reduction in carrying capacity of its habitat. This suggestion is supported by the late age at reaching sexual maturity observed in the Mediterranean population as compared to other conspecific or even congeneric populations (Aguilar, 2000).

Antoine et al. (2001) evaluated that by-catch rates in the tuna drift-net fishery in the North East Atlantic were to 90% composed of *Delphinus delphis* and *Stenella coeruleoalba*. Mean catch rate by trip in the years 1992–1993 were 4.7 striped dolphins per km of net and per day. Such rates are similar to those estimated in other driftnet fisheries. Goujon (1996) estimated the annual additional mortality linked to the driftnets in the Bay of Biscay albacore tuna fishery to 1.8% for the striped dolphin (this estimate must be increased by 30% in order to take into account the whole European albacore tuna driftnet fishery). For the striped dolphin the long term possibility of a significant population decrease cannot be excluded.

In the South West Atlantic, by-catch of *S. coeroleoalba* was noted by Zerbini and Kotas (1998) off Brazil.

Pollution: Contaminants have been studied more intensively in this species than in any other cetacean. A long series of papers has reported the levels, accumulation rates, distribution, relationships and transfer dynamics of organochlorine compounds and heavy metals in striped dolphins taken in the Japanese drive fishery. Levels of organochlorines were similar to those in other small cetaceans in the same region and higher than levels in the southern hemisphere. Other areas sampled include the Mediterranean, the Atlantic coast of France, Wales, the US east coast and the eastern tropical Pacific (Perrin et al. 1994 and refs. therein).

According to Reyes (1991 and refs. therein), extremely high concentrations of heavy metals, DOT and PCBs are reported in specimens from the Mediterranean and Japan. The presence of high levels of heavy metals was associated with lung pathology in Mediterranean cetaceans. Recent studies revealed high levels of mercury in striped dolphins from the Ligurian, Adriatic, and Thyrrenian Seas (Cardellicchio, 2000).

Monaci et al. (1998) found that mercury levels were higher in tissues from animals stranded on the Italian coasts and in skin biopsies obtained in the Tyrrhenian and Ligurian Seas, than in the respective Spanish samples. This is probably related to Hg pollution from the natural weathering of cinnabar ores in central Italy. Geographical differences in trace-element accumulation patterns may reflect the existence of two different populations of *Stenella coeruleoalba* in the western Mediterranean.

According to Aguilar (2000) tissue levels of organochlorine compounds, some heavy metals and selenium are high in Mediterranean samples and exceed threshold levels above which detrimental effects commonly appear in mammals. However, apart from the indication that these levels may have acted as triggering factors in the 1990-1992 epizootic by depressing the immune system of diseased individuals and potential lesions in the ovaries, no information on pollutant-related effects is available.

Overfishing: The European anchovy is the most heavily exploited pelagic resource in the Mediterranean, where some other stocks of pelagic fish are already over-exploited. Since striped dolphins are reported to eat anchovies and sardines in the area, this could eventually become either a source of conflict with the commercial fisheries or a potential threat for dolphin populations (Reyes, 1991). The 1990-1992 epizootic devastated the whole Mediterranean population; over one thousand corpses were examined in the western Mediterranean alone, but the toll was probably much higher. The causative agent of the die-off was a morbillivirus, but the effect of some pollutants and decreased food availability were suggested as triggering factors. Depletion of fish and cephalopod resources is widespread in the Mediterranean and, given that the diet of striped dolphins includes commercial species, this undoubtedly has a potential for limiting population numbers (Aguilar, 2000).

7. Remarks

To date, striped dolphins have faced relatively few threats compared with other small cetacean species, although very little is known about the species in some areas. However, some discrete populations are affected either by both direct and indirect catches or by habitat encroachment. In particular the direct catches off the Pacific coast of Japan are a matter of concern, as was expressed by the International Whaling Commission. The levels of contamination in the Mediterranean Sea, coupled with the increasing incidental catches in the driftnet fishery and reduced prey availability represent the major threats for this and other cetacean species in the area (Reyes, 1991).

Stenella coeruleoalba is categorised as "Lower Risk, conservation dependent" by the IUCN. The eastern tropical Pacific population and the western Mediterranean population are included in Appendix II of CMS. However, observations off the coast off Japan also indicate migratory behaviour in these waters. Range states concerned in these waters are Japan, North and South Korea, the Peoples Republic of China and Taiwan (see Perrin et al. 1996 in Appendix 2). Therefore, it is recommended that the West Pacific Stock also be included in Appendix II of CMS.

Range States for the western Mediterranean population are Algeria, France, Italy, Malta, Monaco, Morocco, Spain and Tunisia. Range States for the ETP populations are Colombia, Costa Rica, Ecuador, El Salvador, France (Clipperton Island), Guatemala, Honduras, Mexico, the Netherlands, Nicaragua, Panama, Peru, Spain, the United States and Vanuatu (see Hucke-Gaete, 2000 in Appendix 1).

Further research should be focused on stock identity and abundance, the effects of direct and incidental mortality, and the effects of pollutants and other sources of habitat disturbance on dolphin populations, in particular in the western Mediterranean (Reyes, 1991).

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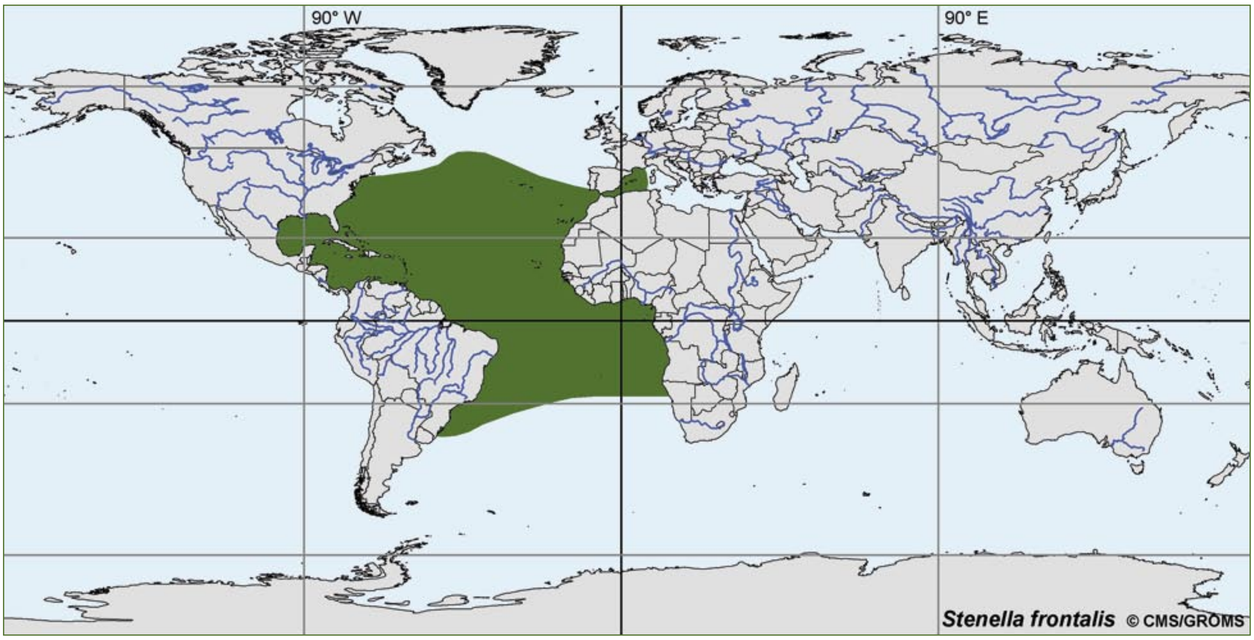
5.65 Stenella frontalis (G. Cuvier, 1829)

English: Atlantic spotted dolphin
German: Zügeldelphin
Spanish: Delfín pintado
French: Dauphin tacheté de l'Atlantique

Drawing of Stenella frontalis © Wurtz-Artescienza.

1. Description

S. frontalis can be distinguished from *S. attenuata*, which also occurs in the tropical Atlantic, by its spinal blaze which sweeps up into the dorsal cape. In addition, the peduncle does not exhibit the dorsoventral division into darker and lighter lower halves observed in *S. attenuata*. Animals of this species are not always spotted, unlike the smaller or more delicate dark form occurring in the Gulf Stream and central North Atlantic, or as heavily spotted and therefore almost white like the large form which is found on both sides of the Atlantic. Usually, spots first appear at 2–6 years of age and increase in size and density up to 16 years. The beak is of medium length and sharply demarcated from the melon and the dorsal fin is falcate. Adult size



Distribution of Stenella frontalis (mod. from Perrin et al. 1994; © CMS/GROMS). Warm, temperate, subtropical and tropical waters in the North- and South-Atlantic.

ranges from 166 cm to 229 cm and mass reaches up to 143 kg (Perrin, 2002).

There is a marked regional variation in the size and shape of the skull, and in adult body size (Perrin et al. 1987, in Rice, 1998). The largest individuals inhabit the coastal waters of the south-eastern United States; these are the animals that long went under the name *S. plagiadon* (Cope, 1866), and they may yet be recognised as a valid subspecies once a range-wide study has been completed (Rice, 1998). Although a smaller, less spotted form seems to be more pelagic than a larger, heavily spotted form (Carwardine, 1995), no populations or subspecies were formally recognised by 2000 (van Waerebeek et al. 2000).

2. Distribution

Stenella frontalis ranges in the tropical and warm temperate Atlantic, north to the Gulf of Mexico, Cape Cod, the Azôres, and the Canary Islands, and south to Rio Grande do Sul in Brazil, Saint Helena, and Gabon. A synonym is *Stenella froenata* (F. Cuvier, 1829) (Rice, 1998). The species is well documented from Equatorial Guinea and Côte d'Ivoire, with recent sightings at sea off Senegal (van Waerebeek et al. 2000 and refs. therein). The range therefore extends roughly from about 50°N to 25°S (Jefferson et al. 1973).

3. Population size

Atlantic spotted dolphins are thought to be the most common offshore species in the Gulf of Mexico and off the south-eastern United States, but efforts in the 1980s to estimate abundance in the Gulf and on the mid- and North Atlantic continental shelf did not attempt to differentiate between this species and the pantropical spotted dolphin, *S. attenuata* (Perrin et al. 1994 and refs. therein). There is no data available from West Africa, but the few records suggest that it is not abundant or that it has an offshore distribution (van Waerebeek et al. 2000).

4. Biology and Behaviour

Habitat: The large, heavily spotted form of the Atlantic spotted dolphin along the south-eastern and Gulf coasts of the United States inhabits the continental shelf, usually being found inside or near the 100-fathom curve (within 250–350 km of the coast) but sometimes coming into very shallow water adjacent to the beach seasonally, perhaps in pursuit of migratory forage fish. It is usually replaced in nearshore waters by the bottlenose dolphin, *Tursiops truncatus*. In the Bahamas, Atlantic spotted dolphins spend much time in shallow water (6–12 m) over sand flats. The smaller and less-spotted forms that inhabit more pelagic offshore waters and waters around oceanic islands are less well known in their habitat requirements (Perrin et al. 1994 and refs. therein; Jefferson and Schiro, 1997) However, as the map indicates, the species is also known from far-offshore Gulf-stream and the mid-tropical Atlantic (W. Perrin, pers. comm.).

Davis et al. (1998) characterised the physical habitat of cetaceans found along the continental slope in the north-central and western Gulf of Mexico. Atlantic spotted dolphins were consistently found in the shallowest water on the continental shelf and along the shelf break within the 250-m isobath (Davis et al. 1996). In addition, the bottom depth gradient (sea floor slope) was less for Atlantic spotted dolphins than for any other species.

Schooling: Small to moderate groups, generally of fewer than 50 individuals, are characteristic of the Atlantic spotted dolphin. Coastal groups usually consist of 5 to 15 animals (Jefferson et al. 1993). On both coasts of northern Florida, moving groups may consist of up to 100 individuals and may attract other, smaller groups that join the large group briefly. Segregated schools of subadults and adults without calves and of adults with calves have also been observed (Perrin et al. 1994 and refs. therein).

In a new report from the Canary Islands maximum group size of *S. frontalis* is given as 650 animals (mean 40) out of 321 sightings between 1994-2001 (Ritter, 2003).

Herzing and Johnson (1997) observed interspecific interactions between free-ranging Atlantic spotted dolphins and bottlenose dolphins in Bahamian waters. Mixed-sex, mixed-species adult groups (including pregnant females) were seen foraging together and travelling together.

Food: A wide variety of fish and squids are taken by this species (Jefferson et al. 1993): The stomach of a specimen captured off northern Florida contained a large number of small cephalopod beaks, and dolphins of this species have been observed to feed on small clupeoid and carangid fishes and large squid and to follow trawlers to eat discarded fish. Observers in the north-eastern Gulf of Mexico have reported that small squid have been regurgitated during captures of spotted dolphins (Perrin et al. 1994). Fertl and Würsig (1995) report that in the Gulf of Mexico Atlantic spotted dolphins fed in a co-ordinated manner and herded a school of clupeid fish into dense balls against the sea surface. While such feeding activity for other delphinid species has been well-described nearshore, this is one of the first reports of co-ordinated feeding offshore.

Clua and Grosvalet (2001) report that each summer the presence of large concentrations of bait fish in the area of the central Azores Islands gives rise to mixed-species feeding aggregations usually at dawn and dusk. The encircling of prey initiated by common dolphins (*Delphinus delphis*), often mixed with spotted dolphins (*Stenella frontalis*), results in the formation of a compact 'ball' of several thousand prey fish close to the surface. Other dolphins, in particular the bottlenose (*Tursiops truncatus*), also eat the prey fish, whose high concentration makes them easy to capture. Large tunas (*Thunnus thynnus*, *Thunnus albacares*) sometimes participate in the phenomenon. Seabirds (mainly cory's shearwaters, *Calonectris diomedea borealis*) are always present throughout the few minutes during which the entire collective food hunt takes place. Clua and Grosvalet (2001) show that it is the tunas that generate and benefit from the aggregation with dolphins, rather than the contrary.

Dives to 40–60 m and lasting up to 7 min have been recorded, but most time is spent at less than 10 m (Davis et al. 1996).

5. Migration

The Gulf of Mexico population (and possibly other populations as well) moves close to shore during summer. Usually, these dolphins are found over the offshore continental shelf (Carwardine, 1995).

Davis et al. (1996) report on the diving behaviour and daily movements of a rehabilitated Atlantic spotted dolphin that was tracked in the north-western Gulf of Mexico for 24 d using satellite telemetry. During that time, the animal travelled a total of 1,711 km at a mean travelling speed of 0.8 m/s. The mean minimum distance travelled daily was 72 km. Although this single animal can hardly be considered representative for the species, it illustrates the habitat use and movements within the marine habitat. International borders (e.g. Between Texas and Mexico) are not limiting for wild populations.

Mignucci et al. (1999) assessed cetacean strandings (including Atlantic spotted dolphins) in waters off Puerto Rico and the United States and British Virgin Islands. Between 1990 and 1995, the average number of cases per year increased from 2.1 to 8.2. The seasonal pattern of strandings was not found to be uniform, with a high number of strandings occurring in the winter and spring. The monthly temporal distribution showed an overall bimodal pattern, with the highest number of cases reported for February, May and September.

6. Threats

Direct catches: Atlantic spotted dolphins are taken in a direct fishery for small cetaceans in the Caribbean. Direct takes may also occur off the Azores and off West Africa (Jefferson et al. 1993; Perrin et al. 1994).

Incidental catches: Some are probably taken incidentally in tuna purse seines off the West African coast. However, there are no reliable estimates of the number of animals taken in these fisheries (Jefferson et al. 1993; Carwardine, 1995), but it may be considerable. Atlantic spotted dolphins are also captured incidentally in gill nets in Brazil and Venezuela (e.g. Zerbini and Kotas, 2001). In Venezuela, the dolphin carcasses are utilised for shark bait and for human consumption (Perrin et al. 1994).

Mignucci et al. (1999) found that the most common human-related cause categories observed in strandings were entanglement and accidental captures, followed by animals being shot or speared. Nieri et al. (1999) report that in 1995, a large number of dolphins washed ashore on the sandy beaches north of Nouakchott, the capital of Mauritania. Officers from the Parc National du Banc d'Arguin and researchers from the University of Barcelona surveyed the coastline to assess the number of corpses and the cause of death, which was attributed to fishery interaction.

For another fishery Delgado (1997) reports that dolphins in Campeche Sound, Mexico, stayed behind shrimp catch vessels and ate the discarded bycatch (mainly at night). Because dolphins respected trawl net position, the probability of incidental catch appeared low.

Pollution: Watanabe et al. (2000) determined concentrations of polychlorinated biphenyl congeners (PCBs) and organochlorine pesticides in the livers of Atlantic spotted dolphins found stranded along the coastal waters of Florida, USA, during 1989 to 1994. The PCBs were the most predominant contaminants followed in order by DDTs, chlordanes, tris(4-chlorophenyl)methane (TCPMe), tris(4-chlorophenyl) methanol (TCPMOH), hexachlorobenzene, and hexachlorocyclohexane isomers. Among the cetaceans analysed, organochlorine concentrations were greatest in bottlenose dolphins followed by Atlantic spotted dolphins and pygmy sperm whales. The hepatic concentrations of TCPMe and TCPMOH in bottlenose dolphins and Atlantic spotted dolphins were greater than those in the blubber of marine mammals of various regions, which suggested the presence of sources for these chemicals along the Atlantic coast of Florida.

7. Remarks

Atlantic spotted dolphins seem to prefer inshore waters on both sides of the tropical Atlantic and may venture even further. Satellite telemetry showed that the species is capable of moving considerable distances, and stranding data show seasonal peaks. These data show that movements and home range size are likely to stretch across international boundaries.

Range states include the US, Mexico, Belize, Honduras, Nicaragua, Coasta Rica, Panama, Colombia, Venezuela, Guyana, Suriname, French-Guyana, Brasil, Cuba, Bahamas, Dominican Rep., Haiti, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte D'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroun, Gabun, Rep. Congo, Dem. Rep. Congo, Angola and Namibia.

Inclusion in Appendix II of CMS is therefore strongly suggested

The species is listed as "Data Deficient" by the IUCN.

Atlantic spotted dolphins also occur in South America, so please see Hucke-Gaete (2000) in Appendix 1 for further recommendations. Range states in the Caribbean should be encouraged to investigate into and reduce accidental by-catch.

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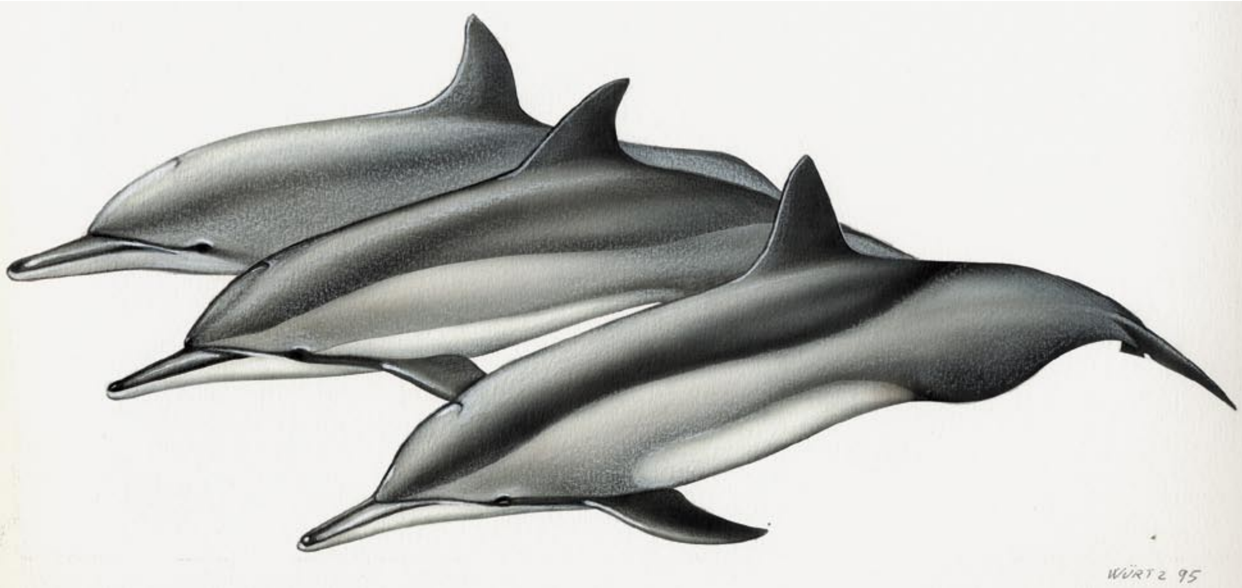
5.66 Stenella longirostris (Gray, 1828)

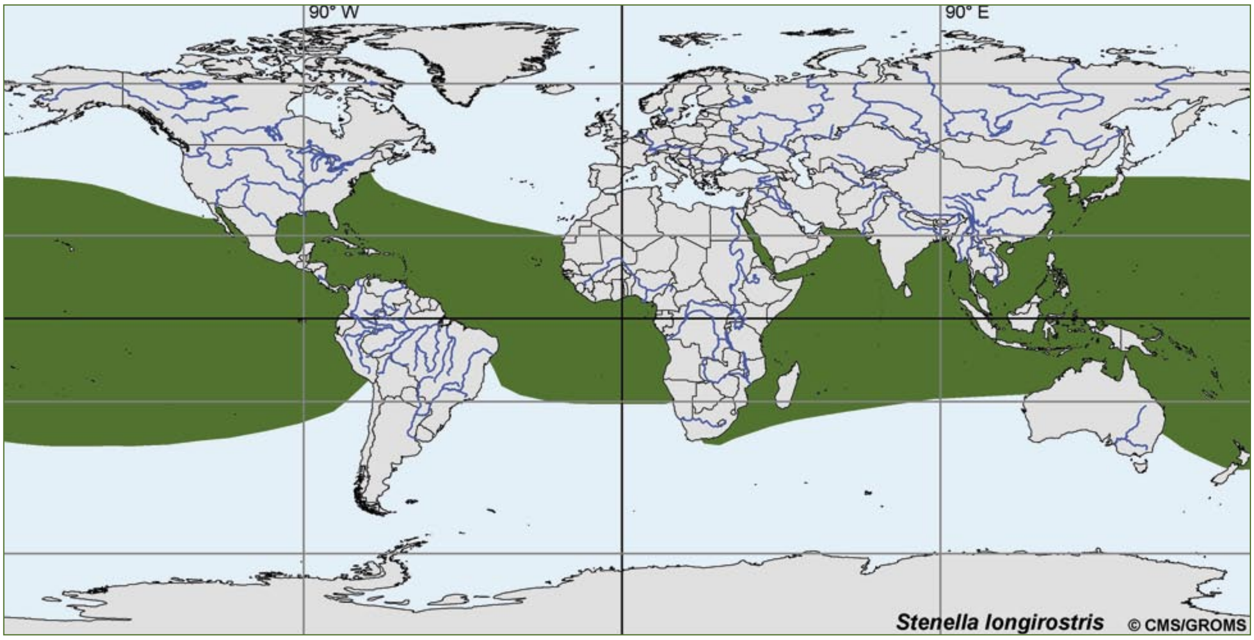
English: Spinner dolphin
German: Ostpazifischer Delphin
Spanish: Estenela giradora
French: Dauphin longirostre



Drawing of Stenella longirostris © Wurtz-Artescienza.

1. Description

Spinner dolphins can be identified by their relatively long, slender beak, color pattern and fin. Colouration consists of a dark grey cape, light grey lateral field and white ventral field. A dark band runs from the eye to the flipper, bordered above by a thin light line. The rostrum is tipped with black or grey. The dorsal fin is basically triangular, slightly falcate to erect. Adults range from 129–235 cm and reach a body mass of 23–78 kg (Perrin, 2002).



Distribution of Stenella longirostris. Four different subspecies occur in tropical and subtropical waters in the Atantic, the Indian and Pacific Oceans: S. l. longirostris, S. l. orientalis, S. l. centroamericana and S. l. roseiventris (mod. from Perrin, 1998; Perrin and Gillpatrick, 1994; © CMS/GROMS).

2. Distribution

Spinner dolphins are pantropical, occurring in all tropical and subtropical waters around the world between roughly 30-40°N and 20-30°S (Jefferson et al. 1993). The geographical variation in body configuration and colour pattern is more pronounced in spinner dolphins than in any other species of cetacean. Perrin (1990) and Perrin et al. (1999) expressed this variation by naming four subspecies:

S. l. longirostris: Occurs mainly around oceanic islands in the tropical Atlantic, Indian, western and central Pacific east to about 145°W. It ranges north to New Jersey, Senegal, the Red Sea, Gulf of Oman, Arabian Sea, Sri Lanka, the Andaman Sea, Gulf of Thailand, southern Honshu, and the Hawaiian Islands (Rice, 1998). Smith et al. (1997a and 1997b) sighted individuals off Myanmar and Vietnam. This subspecies ranges south to Paraná in Brazil, Saint Helena, Cape Province, Timor Sea, Queensland, and Tonga Islands and is vagrant to New Zealand (Rice, 1998).

However, the distribution of *S. l. longirostris* in the Atlantic is very poorly known, especially in South American and African waters; the known range can be expected to expand considerably in those areas with increased attention to the cetacean faunas there. The species is a tropical one, however, and most definitely does not occur in subantarctic waters as indicated previously. The southernmost record is from New Zealand, more than 2000 km south of what is thought to be the normal range but still well north of subantarctic waters (Perrin and Gilpatrick, 1994 and refs. therein). Van Waerebeek et al. (2000) note a lack of recent sightings, strandings or by-catches off West Africa, whereas Ali and Jiddawi (1999) report sightings on the coast of Zanzibar in the Western Indian Ocean.

The many regional populations currently subsumed under the name *S. l. longirostris* differ somewhat in size and other features, and further study may indicate that it would be useful to recognise additional subspecies. It has been claimed that the spinner dolphins in the north-western Indian Ocean are smaller and have a slightly different colour pattern. Perrin (1990) proposed the name "Gray's spinner dolphin" for this race; the "Hawaiian spinner porpoise" is included here. The "Whitebelly spinner porpoise" and the "southern spinner dolphin" are intergrades or hybrids between this race and *S. l. orientalis* (Rice, 1998 and refs. therein).

S. l. orientalis Perrin, 1990: Ranges in pelagic waters of the tropical Pacific east of about 145°W, from 24°N off Baja California south to 10°S off Peru, but exclusive of the range of the following race. This is the "eastern spinner dolphin" of Perrin (1990).

Perryman and Westlake (1998) examined lengths of spinner dolphins taken from vertical aerial photographs in the eastern tropical Pacific and found three unique morphotypes. Two of these forms correspond, at least in average length and distribution, to the existing Eastern and Central American subspecies. The third form is intermediate in length between the two recognised subspecies and is found along the edge of the continental shelf north of Cabo Corrientes, Mexico. They provisionally call this form the "Tres Marias spinner dolphin."

S. l. centroamericana (Perrin, 1990): This subspecies is found in coastal waters over the continental shelf of the tropical Pacific from the Gulf of Tehuantepec in southern Mexico southeast to Costa Rica. This is the "Central American spinner dolphin" of Perrin (1990).

S. l. roseiventris (Wagner, 1846): is distributed in shallow innner waters of Southeast Asia, including the Gulf of Thailand, Timor and Arafura Seas, and similar waters off Indonesia, Malaysia and Northern Australia. It is replaced in deeper and outer waters by the larger pelagic subspecies *S. l. longirostris* (Perrin et al. 1999).

Based on morphological data, van Waerebeek et al. (1999) conclude that Oman spinner dolphins should be treated as a discrete population, morphologically distinct from all known spinner dolphin subspecies. Confirmed coastal range states off the Arabian Peninsula include the United Arab Emirates, the Sultanate of Oman, Yemen, Somalia, Djibouti, Saudi Arabia, Sudan and Egypt.

3. Population size

Large numbers have been killed incidentally since the early 1960's by tuna purse seiners in the eastern tropical Pacific (Perrin, 2002): whereas the original population size of the **eastern spinner** dolphin was roughly 1.5 million, the 1979 size reached only 0.3 million (Perrin and Gilpatrick, 1994 and refs. therein).

For the **whitebelly spinner**, the decline in the 60's and 70's was from 0.4-0.5 million to 0.2-0.4 million (Perrin and Gilpatrick, 1994 and refs. therein). Indices for the following years suggest some increase in abundance. Anganuzzi et al. (1991) confirmed downward trends in the eastern and white-belly stocks possibly extending into the early or mid-1970s but found little change, if any, in more recent years. The **northern whitebelly** spinner stock experienced a notable decline from 1976 to 1980, remaining relatively stable since, with slight indications of increase. However, large fluctuations of unknown origin were observed over the years. Estimates for the **southern whitebelly** stock show little evidence of population changes, although the pattern for this may be approximately the same as that for the northern whitebelly spinner (Reyes, 1991 and refs. therein).

The most recent estimates of absolute population size (Wade and Gerrodette, 1992, in Perrin and Gilpatrick, 1994) are 583,500 for the **eastern spinner** and 992,400 for the **whitebelly spinner**. For the Eastern Tropical Pacific Ocean, Gerodette (1999) reports a population size of 339,000 eastern spinner dolphins.

Balance and Pitman (1998) conducted a cetacean survey in the pelagic Western Tropical Indian Ocean (WTIO) and report that the cetacean community there was similar to that of the Eastern Tropical Pacific (ETP) and the Gulf of Mexico (GM) Regardless of ocean, three species comprised the majority of cetaceans in the community, *Stenella attenuata*, *S. longirostris*, and *S. coeruleoalba*, representing 62%–82% of all individuals for all species. However, the rank order of abundance for these three species differed with ocean.

Dolar et al. (1997) surveyed marine mammal distribution and abundance and investigated interactions with humans in the southern part of the Sulu Sea and north-eastern Malaysian waters. Population size estimates for spinner dolphins were around 4,000 individuals. For the eastern Sulu Sea, Dolar (1999) estimates abundance at 30,000 eastern spinner dolphins.

4. Biology and Behaviour

Habitat: In most tropical waters, nearly all records of spinner dolphins are associated with inshore waters, islands or banks. Around Hawaii spinner dolphins depend on the availability of sheltered shallow bays for use as resting areas during the day. In the eastern tropical Pacific, however, spinner dolphins, like pantropical spotted dolphins, occur in very large numbers on the high seas many hundreds of miles from the nearest land. The spotted dolphin school may serve as a surrogate "protected bay" for the spinner dolphins to shelter them from predators during their daily quiescent period, thus allowing them to exist and make a living far from land. The habitat there, called by oceanographers "tropical surface water", is typified by unusual conditions of shallow mixed layer, shoal and sharp thermocline, and relatively small annual variation in surface temperature (Reyes, 1991, Perrin and Gilpatrick, 1994 and refs. therein).

The dwarf form of the spinner dolphin in Thai waters apparently inhabits a shallow coral reef habitat (Perrin and Gilpatrick, 1994 and refs. therein).

Davis et al. (1998) characterised the physical habitat of cetaceans found along the continental slope in the north-central and western Gulf of Mexico. *Stenella longirostris* was found over intermediate bottom depths, its distribution overlapping with that of purely pelagic and purely coastal species.

Schooling: The spinner dolphin society is composed partly of familial units and more broadly of learned associations beyond the family group. Mother-calf bonds are persistent, as in other dolphins. Social groupings are very fluid, with individuals moving freely among several sets of companions over periods of minutes, hours, days or weeks. Large schools form, break down and re-form with different permutations of subgroups in the course of diurnal inshore-offshore and longshore movements related to nocturnal feeding. It is not known whether or not these broader associations are with members of dispersed kin groups. There is some segregation by age and sex among schools of spinner dolphins in the far-offshore eastern Pacific. It has been suggested that such segregation may be temporary and more pronounced during migration in dolphins. There appears to be no consistent "leader" in a spinner dolphin school. Directional movement appears to be a group process, with direction imparted often from behind, to the sides or below in the school. In a time of stress, the school becomes what has been termed a "sensory integration system" (SIS) and direction may come from anywhere in the school (Perrin and Gilpatrick, 1994, and refs. therein).

In the Eastern Tropical Pacific spinner dolphins are often found in close association with pantropical spotted dolphins, yellowfin tuna and birds of several species and may use spotted-dolphin schools as refugia during diurnal quiescent resting periods; the association varies in percentage occurrence with time of day (Perrin and Gilpatrick, 1994, and refs. therein).

Food: Spinner dolphins feed primarily on small (generally less than 20 cm) mesopelagic fish, squids and sergestid shrimps, diving to at least 200–300 m. In Hawaii, many prey organisms become available to spinner dolphins when the deep scattering layer moves toward the surface at night. Spinner dolphins in the Gulf of Thailand may have an entirely different trophic ecology, feeding on benthic and coral reef organisms (Perrin and Gilpatrick, 1994, and refs. therein).

5. Migration

Reilly (1990) found strong seasonal shifts in habitats for the spinner and spotted dolphins but not for common dolphins. There seems to be not only pronounced year-to-year variation in habitat distribution but also sharply definable differences between preferred habitats of eastern and whitebelly spinners, the former were encountered more frequently in regions of relatively sharp thermocline (Perrin and Gilpatrick, 1994 and refs. therein).

Perrin and Gilpatrick (1994, and refs. therein) summarise that in Hawaii, spinner dolphins usually spend the daytime hours resting in shallow bays near deep water. They move offshore at dusk to feed. During feeding, they may move some distance along the shore, so the same animals may not be present in the same bay on two successive days. Not all animals go into the rest coves every day; some move slowly along the shore between successive nights. Maximum net movement observed was 113 km over 1,220 days. Marten and Psarakos (1999) report on the strong site-fidelity in Hawaiian animals. At least one and up to three animals were re-sighted north-west of Oahu 20 years after the first reported sighting.

Spinner dolphins at Fernando de Noronha Island off northern Brazil exhibit daily movements similar to those observed in Hawaii. Seven tagged spinner dolphins in the eastern tropical Pacific moved minimum distances of 12 to 275 nautical miles (within 16h and 365 days, respectively). Maximum time at liberty was 776 days (minimum distance travelled 172 nautical miles). The number of tag returns (seven of 340) was insufficient to allow detection of a migratory pattern if one exists. Minimum distances moved were less than for pantropical spotted dolphins at liberty for similar periods of time; the spinner dolphin may be less migratory (Perrin and Gilpatrick, 1994, and refs. therein).

Norris et al. (1994) summarise that spinner dolphin distribution and abundance is related to certain local oceanographic phenomena. For example, divergence zones at current margins and current ridges both concentrate food organisms and are heavily frequented by dolphins of various species, including spinners. Whereas one scientific view suggests that populations remain geographically stable over rough bottom topography, another view suggests that at least some populations may move widely without reference to the bottom. Where a warm current swings away from the tropics along an ocean margin—for example where the Kuroshiro current moves northward along the eastern shore of Japan—oceanic dolphin populations, including the spinner dolphin, migrate in such water masses and move considerable distances.

6. Threats

Directed fisheries: Small numbers of spinner dolphins are taken in localised harpoon fisheries in many places around the world, e.g. the Lesser Antilles, the Philippines, and Indonesia. They were formerly taken in small numbers in drive fisheries in Japan. 117 by-caught spinner dolphins were landed in India in 1986–87, presumably for human consumption. Dolphins taken incidentally in Venezuela are utilised for shark bait and human consumption (Dolar et al. 1994; Perrin and Gilpatrick, 1994 and refs. therein).

Ilangakoon (1997) reports on the interaction between small cetaceans and the fisheries industry in Sri Lanka. He found *Stenella longirostris* to be the most abundantly caught species at all investigated sites. The post-monsoonal period from the end of August to November was the season when peak catches were recorded. Deliberate harpooning was found to account for a sizeable proportion of the small cetacean catch while the practice itself seems to be spreading to new areas.

By-catches: Both the whitebelly and eastern spinner forms have been heavily involved in the tropical Pacific tuna purse seine fishery. The numbers of eastern spinners have been reduced significantly in the last few decades by this fishing practice. Wade (1995) estimated that between 1959 and 1972 by-catch totalled 1.3 million individuals (91,739 per year). Recent reports by Hall (2001) and Bratten and Hall (1997) illustrate the measures taken to reduce by-catch. Levels today are 0 (US vessels) and ca. 3,000 dolphins (all species) for non-US vessels fishing for tuna (Gosliner, 1999).

Gerrrodette (2002) however, states that by 1999, there was no clear indication of a recovery for eastern spinner dolphins. Several factors could be responsible for this:

- cryptic effects of repeated chase and encirclement on survival an/or reproduction (internal injuries, stress, hyperthermia), separation of nursing calves from their mothers during the fishing process. Indeed, Archer et al. (2001) report a calf deficit in the number of lactating spinner dolphin females being killed between 1973 and 1990. These unobserved deaths of nursing calves due to separation from their mothers during fishing indicate that the reported dolphin kill fails to measure the full impact of purse-seine fishing on spotted dolphin populations.

- unobserved or observed but unreported adult mortality,

- effects due to breakup of dolphin schools (increased predation, social disruption),

- ecological effects due to removing tuna from the tuna-dolphin association, and

- ecosystem or environmental changes. See also species account for *S. attenuata* (page 276).

Significant catches of spinner dolphins also occur in the Caribbean, Australia, Japan, the Philippines, and Sri Lanka; in this last area up to 15,000 are killed each year in gillnets and by hand-harpooning. There are likely to be fisheries interactions off West Africa (Jefferson et al. 1993; Perrin and Gilpatrick, 1994; Carwardine, 1995). A trawl shrimp fishery In the Gulf of Thailand takes a yet unknown number of *S. l. Roseiventris* (Reyes, 1991). Zerbini and Kotas (1998) report on by-catches in Brazilian drift-net fisheries and Cockroft (1990) on animals entangled in shark nets off Natal.

Pollution: Relatively high levels of mercury and contamination with DDT, Dieldrin and PCBs have been reported for the species (Tanabe et al. 1993). The high level of Hg has been attributed to natural sources, but in the case of DDT and PCBs the agricultural and industrial development in Central America may be the cause (Velayutham et al. 1994; Velayutham and Venkataramanujam 1995; Perrin and Gilpatrick, 1994 and refs. therein; Reyes, 1991).

Tourism: Tourist development may affect the habitat of some spinner dolphin populations, for example, at Fernando de Noronha Island, Brazil (Reyes, 1991). However, Ali and Jiddawi (1999) report that in Zanzibar the touristic value of *S. longirostris* far exceeded that of using them as bait for sharks. As many as 2,000 tourists visit the dolphin site at Kizimkazi per month. Successful management of the dolphin-tourist trade will ensure continued visitors to the villages where dolphins are present and thus add income to these villages while contributing to management and conservation.

7. Remarks

The eastern tropical Pacific populations and south-eastern Asian populations of *Stenella longirostris* are listed in Appendix II of CMS. The species is listed as "Lower Risk, conservation dependent" by the IUCN.

Range States include Colombia, Costa Rica, Ecuador, El Salvador, France (Clipperton Islands), Guatemala, Honduras, Mexico, the Netherlands, Nicaragua, Panama, Peru, Portugal (Azores), Spain, the United States and Vanuatu, as well as all other maritime nations with tropical or semi-tropical waters. Co-operative research should be continued in order to reduce the incidental mortality and to identify potential sources of habitat degradation, such as pollution and tourist development (Reyes, 1991). Spinner dolphins also occur in South America, so please see Hucke-Gaete (2000) in Appendix 1 for further recommendations. See also general recommendations on Southeast Asian stocks in Perrin et al. (1996) in Appendix 2.

In a recent article on small cetaceans at risk, including the spinner dolphin, Perrin (1999) listed the special problems faced by small cetaceans in general:

- ease of capture,
- vulnerable habitats,
- development of new markets (incidental catches are marketed, see examples above (directed fisheries), and the demand causes more deliberate catches),
- difficulties in monitoring and regulation of incidental kills,
- lack of international management (small cetaceans fall outside the IWC).

Finally "Effective conservation requires meaningful national laws and the will and resources to enforce them, recognition and management of incidental mortality within sustainable limits, continued attention by non-governmental groups, and greater efforts to make the public in the less-well developed countries aware of the value and vulnerability of their dolphins, porpoises, and small whales" (Perrin, 1999).

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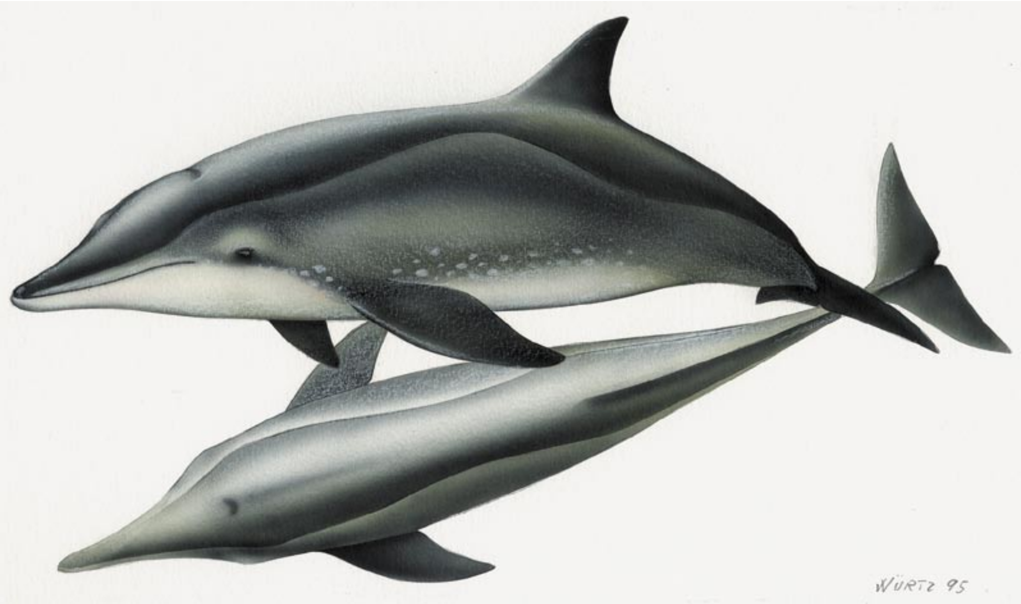
5.67 Steno bredanensis (G. Cuvier in Lesson, 1828)

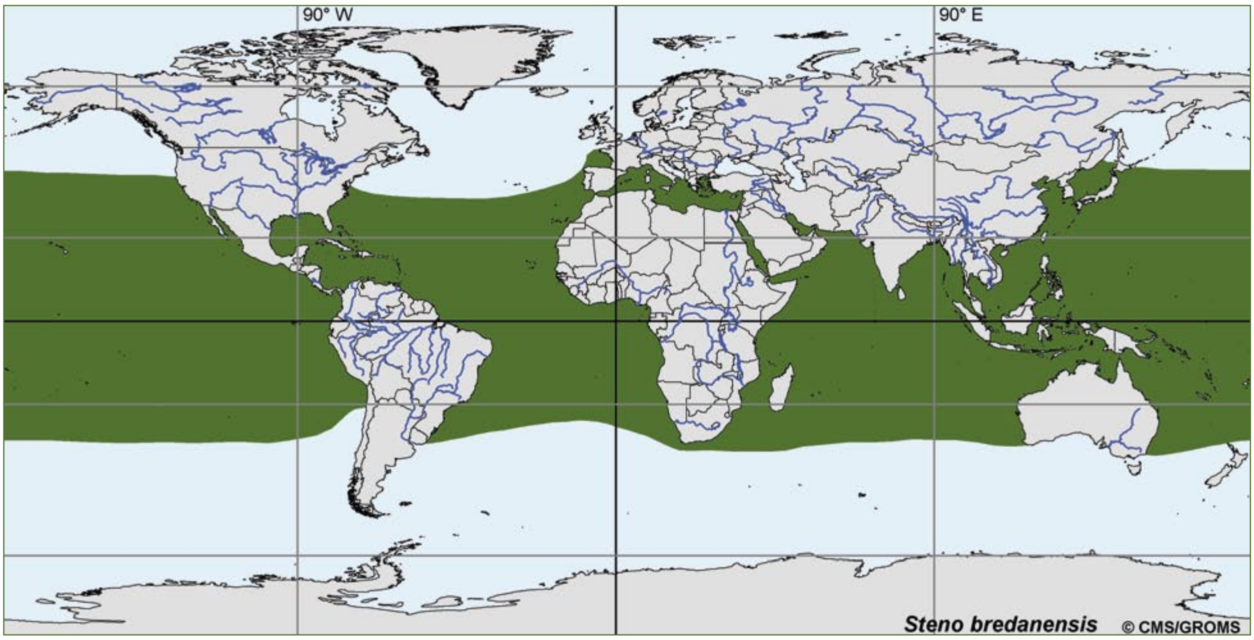
English: Rough-toothed dolphin
German: Rauhzahndelphin
Spanish: Delfin de dientes rugosas
French: Steno



Drawing of Steno bredanensis © Wurtz-Artescienza.

1. Description

This is the only long-beaked dolphin with a smoothly sloping melon that gently blends into the upper beak. The body is not very slender and the anterior may be stocky. The large flippers are set further back on the body than in most other cetaceans. The dorsal fin is tall and only slightly recurved. Some large males may have a hump posterior to the anus resembling a keel. Rough dolphins are countershaded with white bellies and black to dark grey backs. The sides are medium grey and separated from the back by a cape. Size reaches 265 cm and body mass may reach 155 kg (Jefferson, 2002).



Distribution of Steno bredanensis: deep tropical, subtropical and warm temperate waters around the word (mod. from Jefferson, 2002; Carwardine, 1995; © CMS/GROMS).

According to Maigret (1995) *Steno bredanensis* is a species with high morphological variability. Some differences between Atlantic and Pacific specimens have been recorded, especially with respect to rostrum length. These differences may or may not be within the typical range for the species.

2. Distribution

S. bredanensis is distributed in tropical and warm temperate waters around the world. It ranges north to the Gulf of Mexico, Virginia, the Netherlands, Mediterranean Sea, Gulf of Aden, Arabian Sea, Bay of Bengal, East China Sea, Pacific coast of central Honshu, Hawaiian Islands, and Baja California Sur (Rice, 1998). Its southern range extends to Rio Grande do Sul in Brazil, about 32°S in the eastern Atlantic, Natal, Timor Sea, Coral Sea, New Zealand, and Botija (24°30'S) in northern Chile (Rice, 1998). Monteiro et al. (2000) and Ott and Danilewicz (1996) confirm a few sightings an by-catches of *Steno bredanensis* off Brazil. Vagrant north to Oregon and Washington (Ferrero et al. 1994; Rice, 1998).

According to Carwardine (1995) the distribution of *Steno bredanensis* is poorly known, and the map is based on relatively few sightings spread over a wide area. The species does not appear to be particularly numerous anywhere, although researchers have worked mostly in the eastern tropical Pacific and may simply have missed areas of high abundance elsewhere. There have been many more sightings in recent years, especially around Hawaii; and a number of recent sightings off the coast of Brazil suggest a more southerly distribution in the Atlantic. There appears to be a permanent population in the Mediterranean.

3. Population size

An estimated 151,100 rough-toothed dolphins inhabit the eastern tropical Pacific. During a number of survey cruises conducted in the region over a period of approximately 20 years, 176 of 4,006 schools of small cetaceans seen were of rough-toothed dolphins; the species was encountered less often than *Stenella attenuata*, *S. longirostris*, *S. coeruleoalba*, *Delphinus delphis*, *Globicephala macrorhynchus*, *Grampus griseus*, and *Tursiops truncatus* but more often than *Peponocephala electra*, *Orcinus orca*, *Pseudorca crassidens*, *Feresa attenuata*, *Kogia* spp. and beaked whales. However, this ranking could be affected by relative sightability as well as by abundance (Miyazaki and Perrin, 1994 and refs. therein).

4. Biology and Behaviour

Habitat: Most often *Steno bredanensis* is found in deep water far offshore, usually beyond the continental shelf (Maigret, 1995). Off the Canary Island of La Gomera, *S. bredanensis* was found in waters of 506 m mean depth, but mean distance from shore was only 4.4 km (Ritter, 2002). Rough-toothed dolphins appear to be widespread in warm waters around the world, normally where sea surface temperature is above 25°C and seem to avoid cold surface waters and cold currents (Carwardine, 1995). However Ritter (2002) reports that the year-round abundance off La Gomera, Canary Islands, indicates that this species might endure temperatures well below 25°C.

Behaviour: *Steno bredanensis* is a fast swimmer, sometimes porpoising with low, arc-shaped leaps. It may swim rapidly just under the surface, with dorsal fin and a small part of the back clearly visible. Sometimes it bow-rides, especially in front of fast-moving vessels, though not as readily as many other tropical dolphins. Steno may associate with Bottlenose Dolphins and pilot whales and, less frequently, with spinner dolphins and spotted dolphins, and sometimes with shoals of Yellowfin Tuna (Carwardine, 1995; Miyazaki and Perrin, 1994).

Schooling: Schools of up to 50 animals have been reported in the eastern tropical Pacific and central Atlantic (Ritter, 2002) but smaller groups of 10–20 seem more usual. Five schools in Japanese waters contained from 23 to 53 animals. However, these small schools may be parts of larger, dispersed aggregations; one such aggregation of "schools" observed from the air off Hawaii contained an estimated 300 dolphins and another seen in the Mediterranean contained approximately 160 animals in eight groups of about 20 each (Miyazaki and Perrin, 1994 and references therein).

Food: The diet in the wild includes fish and squid. Cephalopods reported from stomach contents include *Teuthowenia* sp. and *Tremoctopus violaceus*. The alga *Sargassum filipendula* was found in the stomachs of several stranded animals; the significance of this is unknown. The stomachs of animals stranded in Hawaii contained the atherinid *Pranesus insularum*, the scomberesocid *Cololabis adocetus*, the belonid *Tylosurus crocodilus*, all nearshore species, and squid. Other, larger fish may be taken in deeper water. Cooperative food gathering has been reported (Miyazaki and Perrin, 1994 and refs. therein). Maximum reported dive depth was 70 m, but they may dive deeper. Maximum dive duration was 15 min (Jefferson, 2002).

5. Migration

The species is difficult to observe at sea: schools are extremely difficult to follow, staying submerged for as long as 15 min (Miyazaki and Perrin, 1994).

Because rough-toothed dolphins seem to prefer warmer waters, it may be hypothesised that the species follows warm currents. It is assumed that the range of *Steno* does not extend beyond the 35th parallel. However, there are no detailed reports on movements and seasonal migrations (Maigret, 1995).

6. Threats

Mass strandings: Miyazaki and Perrin (1994 and references therein) summarise that mass stranding may reduce population size. A school of 17 stranded in Hawaii in 1976. Further mass strandings have been summarised by Maigret (1995). The reasons for such mass strandings are, to date, poorly understood. A possible cause is disorientation, caused by parasites affecting the inner ear, by damage due to military sonar or geological prospection, or by variability in the earth's magnetic field, coupled with altruistic behaviour, herd members not abandoning one another.

In the past 6 years IMMRAC (the Israeli Marine Mammal Research and Assistance Center) has examined 7 strandings of rough-toothed dolphins along the entire Mediterranean Israeli coastline. The species is considered rare in the Mediterranean, and this regional clustering seems rather unusual. It is interesting to notice that all standings have occurred between the months of February – April: presumably during a seasonal migration (Aviad Scheinin, pers. comm.).

Directed fisheries: Small numbers are taken in drive fisheries at Okinawa in the Ryukyus and in the home islands of Japan, the Solomon Islands and Papua New Guinea and by harpoon in Japan, at St Vincent in the Lesser Antilles and in West Africa and possibly formerly were taken at St Helena in the South Atlantic. However, only 23 rough-toothed dolphins were captured in Japan (Okinawa) during the period 1976-81 (Miyazaki and Perrin, 1994 and refs. therein).

By-catches: A few rough-toothed dolphins are killed incidentally in tuna purse seines in the eastern tropical Pacific: 21 were estimated killed during the period 1971–75 and 36 died in a single net haul in 1982. Small numbers are also taken as by-catch in gillnet and driftnet fisheries in Sri Lanka, Brazil, the Central North Pacific and probably elsewhere around the world in tropical and warm-temperate waters (Miyazaki and Perrin, 1994 and references therein).

Monteiro et al. (2000) report on fishery-related mortality along the coast of Ceara state, Northeast Brazil, commenting on the possible conservation implications for the local populations. From January 1992 to December 1998, a total of 13 *S. bredanensis* strandings occurred along the coast. Most animals were recovered at state geographic zones II and III where finfish fisheries and stranding survey efforts were highest. Seasonally, incidental catches were more frequent during the austral spring (October–December). The small number of individuals in conjunction with long gestation and nursing periods, suggest that an increased mortality due to dolphin-fisheries interactions could severely impact local populations of both species.

Pollution: Levels of PCBs and DDE in the blubber of two specimens collected in the western Pacific were lower by two orders of magnitude than those recorded in *Stenella coeruleoalba* and other delphinids (Miyazaki and Perrin, 1994 and refs. therein). Marsili and Focardi (1997) report on chlorinated hydrocarbon concentrations in specimens from the Mediterranean Sea.

7. Remarks

Steno bredanensis has a large distributional range and is known from by-catch in several countries. The biology, life history, population size, and separation into sub-species as well as migratory behaviour are insufficiently known. Research on this species should be encouraged. See also recommendations on South American stocks in Hucke-Gaete (2000) in Appendix 1 and recommendations on Southeast Asian stocks in Perrin et al. (1996) in Appendix 2.

IUCN Status: "Data Deficient". Not listed by CMS.

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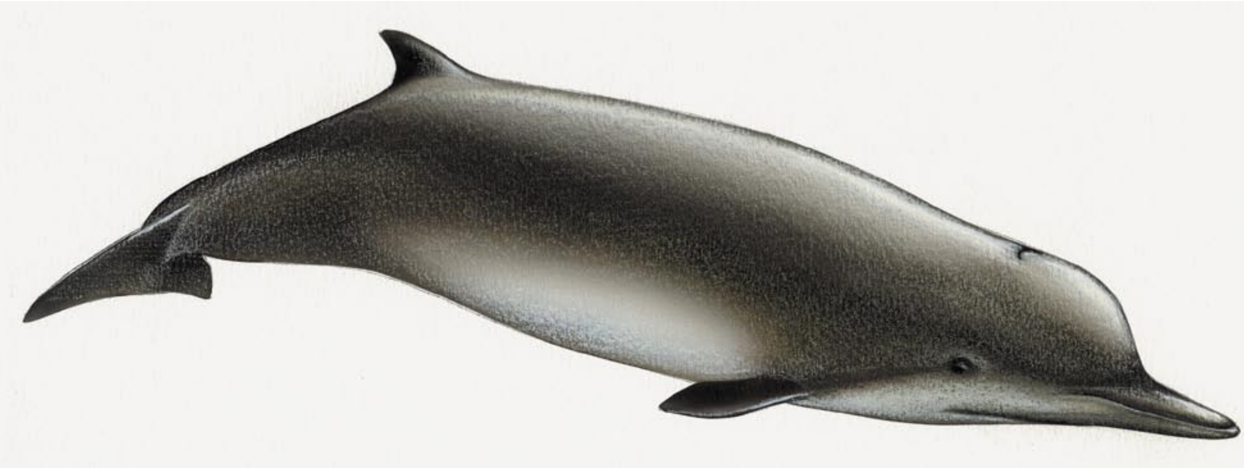
5.68 Tasmacetus shepherdi (Oliver, 1937)

English: Tasman beaked whale
German: Shepherdwal
Spanish: Ballena picuda de Shepherd
French: Tasmacète



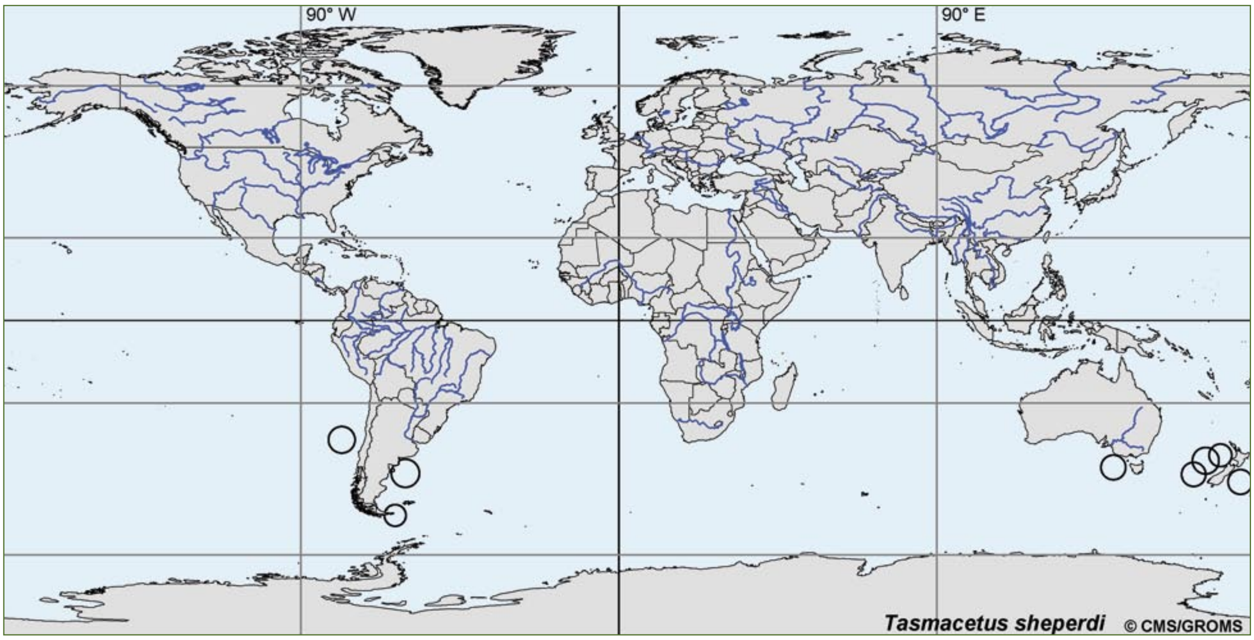
Drawing of Tasmacetus shepherdi © Wurtz-Artescienza.

1. Description

Tasmacetus shepherdi is a rare animal, known from only 21 strandings in the southern hemisphere. Adults are between 6 and 7 m long and have a full set of functional teeth, as opposed to all other beaked whale species. Colouring is dark grey dorsally with a white ventral field extending towards the back on both anterior and posterior sides of the flippers (Mead, 2002).

2. Distribution

Tasman's beaked whale is probably circumglobal in temperate waters of the Southern Hemisphere, but specimens have been collected only in: Tierra del Fuego and Penisula Valdez in Argentina, Tristan da Cunha; South Africa; Port McDonnell in South Australia, North Island, South Island, Stewart Island, and Chatham Island in New Zealand, and Isla Mas Afuera in the Islas Juan Fernández (Rice, 1998).



Distribution of Tasmacetus shepherdi: cold temperate waters of the southern hemisphere, predominantly New Zealand (mod. from Carwardine, 1995; Mead, 2002; © CMS/GROMS).

Putative sightings of live individuals were reported from the western South Atlantic (53°45'S, 42°30'W) and off Christchurch on the east coast of South Island, New Zealand (Rice, 1998).

3. Population size

Nothing is known about the relative abundance of this species or its population composition. It is suspected, based on the lack of identified sightings, that all ziphiids except *Berardius* and *Hyperoodon*, have relatively small populations. This could also be due to their naturally cryptic habits (Mead, 1989).

4. Biology and Behaviour

Habitat: Probably lives mainly far offshore, well away from coasts; however, where there is a narrow continental shelf, *Tasmacetus shepherdi* may sometimes occur in deep water close to shore (Carwardine, 1995).

Behaviour: Very little is known of the natural history of this species. All of the confirmed records are at least partially decomposed strandings. There are only 2 possible sighting records (Jefferson et al. 1993).

Food: They are known to feed on several species of fish, possibly near the bottom in deep waters (Jefferson et al. 1993). This fish diet is reflected by a fully functional set of teeth as opposed to the other ziphiids which mainly live on squid (Carwardine, 1995).

5. Migration

Six of the strandings have occurred in the southern summer (November-March) and one has occurred in the winter (August). This is too small a sample on which to base conclusions on seasonal distribution (Mead, 1989).

6. Threats

There are no records of human exploitation (Jefferson et al. 1993).

7. Remarks

Very little is known about this species. Tasman's beaked whale is listed by the IUCN as "Data Deficient" and not listed by CMS. More information is clearly needed.

T. shepherdi also occurs in southern South America, therefore the recommendations iterated by the scientific committee of CMS for small cetaceans in that area (Hucke-Gaete, 2000 in Appendix 1) also apply.

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5.69 Tursiops aduncus (Ehrenberg, 1833)

English: Indian Ocean bottlenose dolphin
German: Grosser Tümmler des Indischen Ozeans
Spanish: Delfín mular del Oceano Indico
French: Grand dauphin de l'océan Indien

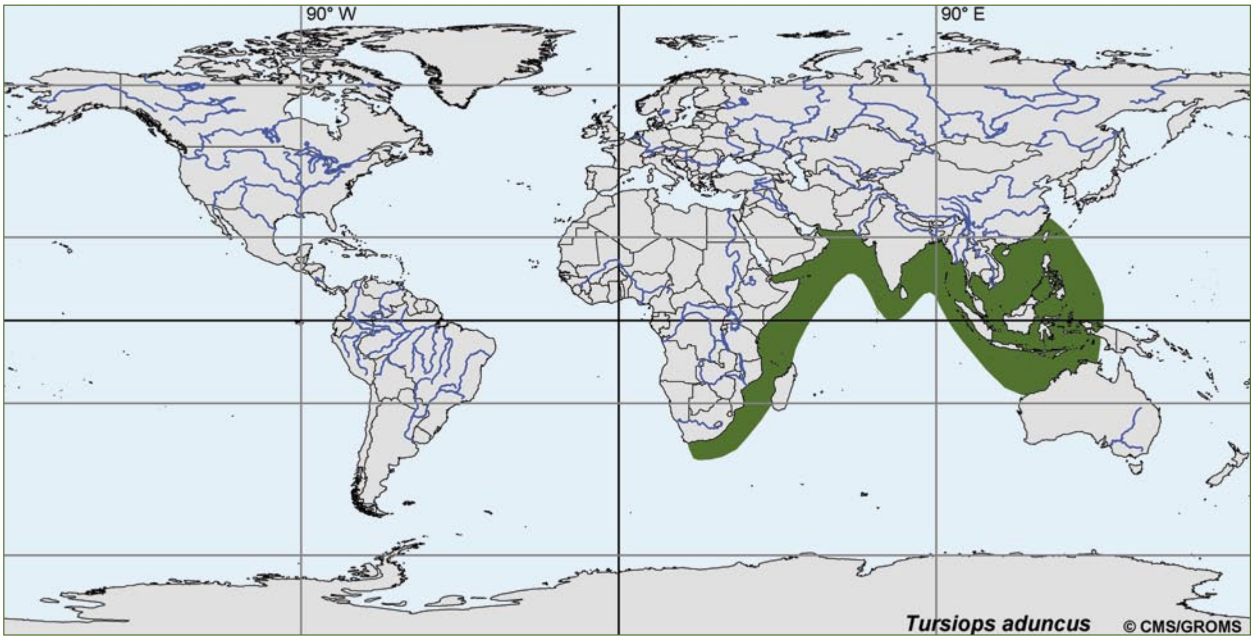
1. Description

T. aduncus tends to be smaller than *T. truncatus* (see page 315), has a proportionately longer rostrum and develops ventral spotting at about the time of sexual maturity (Wells and Scott, 2002).

For Chinese waters, Wang et al. (1999) confirm that two distinct morphotypes of bottlenose dolphins, which have been referred to as *T. truncatus* and *T. aduncus*, exist in sympatry. Comparisons of a 386-bp fragment of the mitochondrial DNA (mtDNA) control region (n = 47) indicate that the two sympatric morphotypes are genetically distinct. Phylogenetic analyses show that the *truncatus*-type dolphins from Chinese waters are more closely related to Atlantic Ocean *truncatus*-type than to the sympatric *aduncus*-type dolphins. These molecular data agree completely with morphological classifications of the specimens. This congruence is strong evidence that the sympatric morphotypes in Chinese waters are reproductively isolated and comprise two distinct species, with important implications for the conservation of bottlenose dolphins in Chinese waters.

New results may justify further subdivisions of *Tursiops* species in the near future: Curry (1997) used 127 mitochondrial DNA control region sequences to investigate intra- and interspecific differences among bottlenose dolphins. She identified 73 haplotypes and the results, combined with information on morphology and ecology, supported the suggestion that there are species-level differences between inshore and offshore bottlenose dolphins in the western North Atlantic / Gulf of Mexico.

Recent genetic evidence suggests that *T. aduncus* is more closely related to pelagic *Stenella* and *Delphinus* species, and in particular to *S. frontalis*, than to *T. truncatus*. Should these findings be confirmed, they would have more than just taxonomic implications and greatly influence segregations based on morphology and social behaviour (Wells and Scott, 2002).



Distribution of Tursiops aduncus: coastal waters of the Indian and Western Pacific Oceans, along the entire coast of Africa, through the Red Sea and Persian Gulf, eastwards as far as Taiwan and south-eastward to the coastal waters of Australia (Wells and Scott, 2002; © CMS/GROMS).

2. Distribution

Investigations by Curry (1997) indicate the separation of *Tursiops aduncus* and *Tursiops truncatus* into two clades: *Tursiops aduncus* ranges along the coast of eastern Africa from Cape Province north to the Red Sea, thence eastward through the Persian Gulf, Arabian Sea, and Bay of Bengal, as far as Taiwan, thence southeast to northern Australia. Möller and Beheregaray (2001) found that coastal *Tursiops* off south-eastern Australia also belonged to the *aduncus* type.

Dolphins from Amami Gunto, between Kyushu and the Ryukyus, also agree with *aduncus* in their spotted underparts and other features. Dolphins from the Hawaiian Islands lack the ventral spotting, as do all but a few old females from the eastern tropical Pacific between southern California and Peru (Rice, 1998 and refs. therein; cf. also Curry, 1997).

3. Population size

Marked geographic variation among bottlenose dolphins—in particular, morphological variation between inshore and offshore animals—has contributed to uncertainties regarding stock structure and taxonomy within the genus. Stock delineations are necessary to assess the impacts of die-off and fishery mortalities on bottlenose stocks, and to conserve population units (Curry, 1997).

4. Biology and Behaviour

no entries.

5. Migration

no entries.

6. Threats

no entries.

7. Remarks

Clearly, more research is needed in order to establish the range and importance of different species, subspecies and their populations of the genus *Tursiops*, as well as basic biological information related to population size, behavioural differences and isolation, and migratory patterns.

Populations of *Tursiops aduncus* in the Arafua / Timor Sea are listed in Appendix II of CMS. The species is not listed by the IUCN. For general remarks on south-east asian species, see Perrin et al. (1996).

8. Sources

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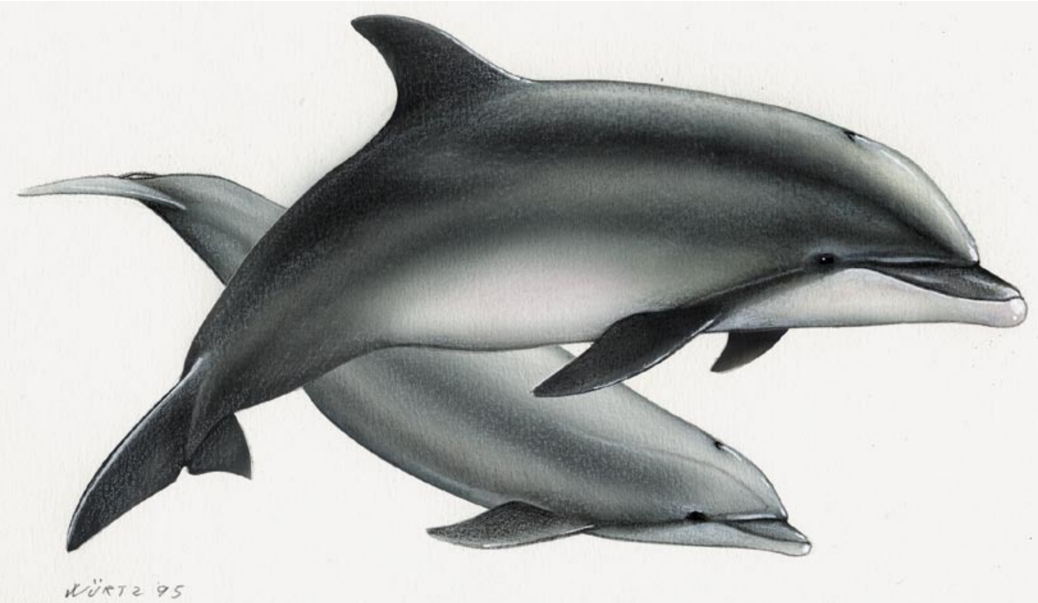
5.70 Tursiops truncatus (Montagu, 1821)

English: Bottlenose dolphin
German: Grosser Tümmler
Spanish: Delfín mular
French: Grand dauphin

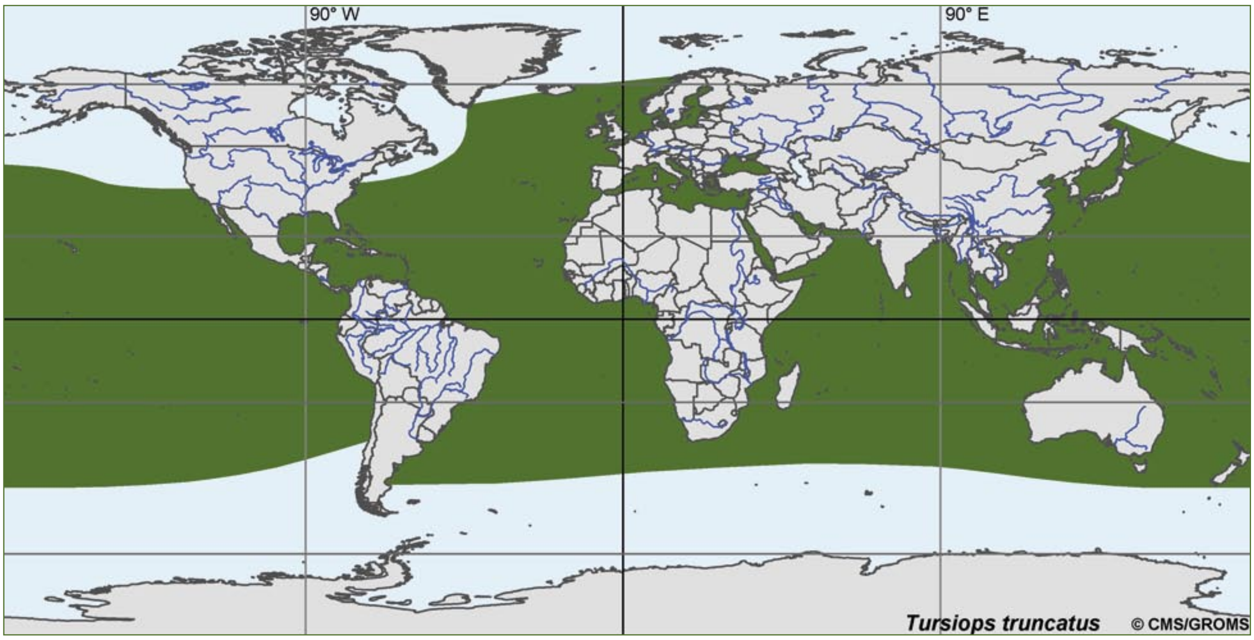


Drawing of Tursiops truncatus © Wurtz-Artescienza.

1. Description

Bottlenose dolphins are recognized by their medium-sized, robust body, moderately curved dorsal fin, and dark coloration, with a sharp demarcation between the melon and the short rostrum. Adult lengths range from 2–3.8 m, weights from 220–500 kg (mean of 242 kg), varying geographically. Body size also seems to vary inversely with water temperature in many parts of the world. The animals are coloured light grey to black dorsally, with a light belly (Bloch and Mikkelsen, 2000; Wells and Scott, 2002).

Despite the wide distribution, abundance, and popularity of bottlenose dolphins, their taxonomy remained muddled for a long time (Rice, 1998).



Distribution of Tursiops truncatus: widely distributed in cold temperate to tropical seas worldwide (map mod. from Wells and Scott, 2002; © CMS/GROMS).

Geographical variation in bottlenose dolphins is only vaguely comprehended, and in most parts of the world subspecific designations are best avoided. The name *T. t. truncatus* (type locality: Great Britain) may be applied to the offshore populations on both sides of the North Atlantic, and some authors have used it for similar animals that live in the temperate waters of the western North Pacific, South Africa, Walters Shoal, southern Australia, and New Zealand. Often, there are size differences between neighbouring populations: The dolphins that live in the Black Sea (named *T. t. ponticus* Barabash-Nikiforov, 1940) are smaller than those in the North Atlantic, while those in the Mediterranean are intermediate in size. In some parts of the world, sharply differentiated inshore and offshore populations live in close proximity. Results of mtDNA analyses do not indicate genetic isolation among offshore populations from different ocean basins, but do show that there are differing coastal or inshore populations which are genetically isolated from offshore populations (Rice, 1998 and refs. therein).

Recent genetic work by Le Duc et al. (1999), osteological comparisons by Wang et al. (2000) and morphological analyses by Hale et al. (2000) support the view that bottlenose dolphins of the tropical Indian Ocean, *T. aduncus*, are reproductively isolated from the widespread *T. truncatus*.

2. Distribution

In the Atlantic *T. truncatus* occurs north to the Gulf of Mexico, George's Bank off Massachusetts, the Azores, the British Isles, The Faroe Islands, the Baltic Sea including the Gulf of Finland, the Mediterranean and Black seas. In the Pacific it ranges north to the Bo Hai (Gulf of Chihli), East China Sea, central Honshu, Kure Atoll, Hawaii, Isla Guadalupe, and Monterey Bay in California. In the Southern Hemisphere *T. truncatus* occurs south to Golfo San Matias in Argentina, 18°S in northern Namibia, Port Elizabeth in Cape Province, Walters Shoal (33°20'S, 43°30'E) in the south-western Indian Ocean, the southern coast of Australia including Tasmania, South Island in New Zealand, and Concepción, Chile (Rice, 1998). Recent evidence (Möller and Beheregaray, 2001), however, suggests that coastal *Tursiops* off south-eastern Australia belong to the *aduncus* type.

Bottlenose dolphins are found primarily in coastal and inshore regions of tropical and temperate waters of the world, and population density seems to be higher nearshore. There are also pelagic populations, such as those in the eastern tropical Pacific and around the Faroe Islands. Except for their occurrence around the United Kingdom and northern Europe, they generally do not range poleward of 45° in either hemisphere (Jefferson et al. 1993). The bottlenose dolphins occurring around the Faroe Islands (62°N 7°W) seem to be the most northerly of the North Atlantic offshore populations (Bloch and Mikkelsen, 2000).

In the North Atlantic, *Tursiops truncatus* is vagrant to Newfoundland and Norway, and in the North Pacific it ranges as far north as Puget Sound in Washington State (Rice, 1998). The species is rare in the Baltic Sea, and there is some question as to their occurrence in the Barents Sea (Wells and Scott, 1999 and refs. therein)

Sykes et al. (2003) investigated the variables that best predict the seasonal distribution of sightings of Bottlenose dolphins along the Dorset coast (England). The factors investigated included salinity, sea surface temperature, chlorophyll a (an indicator of primary productivity) and fish distribution (inferred from landing catch data). Local data sampling validated the use of historical data sets for all the variables. They found that chlorophyll a and fish distribution were the main factors influencing Bottlenose dolphin distribution. Of the 29 fish species investigated, Brill ($P<0.005$), Cuttlefish ($P<0.0001$), Plaice ($P<0.0001$), Pollack ($P<0.005$), Red and Grey Mullet ($P<0.005$), Sole ($P<0.001$), Sprat ($P<0.0001$) and Spurdog ($P<0.0001$) were found to be significant predictors and could explain 88 % of the frequency of dolphin sightings. Stepwise Multiple Regression also identified historical chlorophyll a ($P<0.05$) as a significant predictor of sightings, explaining 13.5 % of the frequency of dolphin sightings. These findings indicate that feeding is an important factor affecting Bottlenose dolphin distribution along the Dorset coast.

3. Population size

Only a few abundance estimates are available for Tursiops from parts of the species' range. In the northern Gulf of Mexico, the population estimate ranges from 35,000–45,000 Tursiops inshore of the 100-fathom contour, an area that extends to more than 250 km from shore. Off the northeast coast of North America, the overall population is approximately 10,000–13,000, of which the inshore form comprises around 4 %. Large-scale research vessel surveys by the US National Marine Fisheries Service (NMFS) produced an estimate of 243,500 Tursiops in the eastern tropical

Pacific. Japanese surveys found 316,935 dolphins in the Northwest Pacific.

Reports for various areas, such as the Mediterranean, identify *T. truncatus* as the most common and abundant dolphin, but estimates of population size are not given. A Russian survey of the Black Sea estimated a population size of 7,000 Tursiops, although the details of the surveys were not presented. Approximately 900 bottlenose dolphins inhabit the 400 km stretch of coastal waters off Natal, south-east of southern Africa (Wells and Scott, 1999 and refs. therein; Reyes, 1991 and refs. therein). In the eastern Sulu Sea, Dolar (1999) estimated the population size at 2,200.

From the North Atlantic Sightings Surveys in 1987 and 1987 (NASS-87 and NASS-89) a very cautious estimate of the bottlenose dolphins around the Faroe Islands comes to about 1,000 animals (Sigurjónsson et al. 1989; Sigurjónsson and Gunnlaugsson, 1990; Bloch and Mikkelsen, 2000).

4. Biology and Behaviour

Habitat: As a result of increased pelagic survey efforts over the last 20 years, researchers have come to recognise *Tursiops* as a truly cosmopolitan species. Although they tend to be primarily coastal, they can also be found in pelagic waters (Wells and Scott, 1999). Bottlenose dolphins exploit a wide variety of habitats. The inshore form frequents river mouths, bays, lagoons and other shallow coastal regions (between 0.5–20 m). Occasionally they may travel far up into rivers.

The offshore form is apparently less restricted in range and movement, and can be found in many productive areas, particularly in the tropics. Some offshore populations are residents around oceanic islands. A coastal habitat seems to be preferred in the Black Sea, with limited movements into offshore waters (Reyes, 1991 and refs. therein). Limits to the species' range appear to be temperature related, either directly, or indirectly through distribution of prey. Off the coasts of North America, they tend to inhabit waters with surface temperatures ranging from about 10°C to 32°C (Wells and Scott, 1999 and refs. therein).

Food: The differences between inshore and offshore *Tursiops* are also reflected in their feeding habits. The inshore form feeds primarily on a variety of fish and invertebrates from both the littoral and sub-littoral zones, whereas mesopelagic fish and oceanic squids are commonly reported as the diet of animals of the offshore form (Reyes, 1991 and refs. therein).

Diet also varies with local prey availability. Along the central US Atlantic coast 31 genera of fish and two species of invertebrates were reported from stomach samples. The four most common prey items were fish: *Cynoscion regalis*, *Micropogonias undulatus*, *Leiostomus xanthurus*, and *Bairdiella chrysoura*. Stomach contents of dolphins caught off South Africa were composed of at least 50 genera of fish and at least three genera of cephalopods. The most important prey included fish: *Trachurus delagoae*, *Pomadasys olivaceum*, *Pagellus bellotti*, and *Scomber japonicus*, and the cephalopods *Sepia officinalis* and *Loligo* sp. This extensive variety of prey inhabits an equally diverse selection of habitats, and includes benthic-reef and sandy-bottom prey and their associated predators, pelagic schooling fish and cephalopods, and deeper-water fish (Wells and Scott, 1999 and refs. therein).

Off Peru, both coastal and offshore dolphins consumed Pacific sardines, anchoveta, and hake, but demersal species such as sciaenids and toadfish were found only in coastal dolphins. By contrast, the offshore animals were the only ones with mesopelagic fish and squids in their stomachs (Wells and Scott, 1999 and refs. therein).

The stomachs of bottlenose dolphins stranded on the Mediterranean coast of Spain contained mainly cephalopods and fish, hake (*Merlucciusa merluccius*) being the most important single prey species. Based on stomach contents, feeding habits were considered to be mostly demersal (Blanco et al. 2001).

Although individual feeding is perhaps most prevalent, co-operative herding of schools of prey fish has been reported from a number of regions. In Mauritania and Brazil, dolphins regularly drive schools of mullet towards fishermen wading with nets in shallow water, and in other regions they have been observed feeding behind shrimp trawls and in the vicinity of small purse seines, collecting discarded fish from these operations after the nets are retrieved, and stealing fish from a variety of fishing gear (Wells and Scott, 1999 and refs. therein).

Schooling: Group size Is commonly less than 2,010, but large herds of several hundred to a thousand are regularly seen offshore (Bloch, 1998; Wells and Scott, 2002). Bottlenose dolphins are commonly associated with other cetaceans, such as pilot whales, white-sided, spotted, rough-toothed and Risso's dolphins, and humpback whales, and hybrids with other species are known from both captivity and in the wild (Jefferson et al. 1993; Bloch, 1998; Wells and Scott, 1999).

Reproduction: Spring and summer or spring and autumn calving peaks are known for most populations (Jefferson et al. 1993; Wells and Scott, 2002).

5. Migration

According to Wells and Scott (1999, and refs. therein; 2002), little is known about the ranging patterns of pelagic bottlenose dolphins, but coastal dolphins exhibit a full spectrum of movements, including 1) seasonal migrations, 2) year-round home ranges, 3) periodic residency, and 4) a combination of occasional long range movements and repeated local residency. Long term residency may take the form of a relatively permanent home range, or repeated occurrence in a given area over many years. For example, the residents of several dolphin communities along Florida's west coast have maintained relatively stable home ranges during more than 28 years of observations. In other areas, residency is long-term but more variable: Dolphins seen frequently during 1974–1976 in Golfo San Jose, Argentina, showed a subsequent decline in frequency of occurrence, but were still occasionally identified in the area 8–12 years later.

Along the central west coast of Florida, communities of resident dolphins appear to inhabit a mosaic of overlapping home ranges. The home range of the Sarasota dolphins encompasses an area of about 125 km^2. Most of the activities of the residents are concentrated within the home ranges, but occasional movement between ranges occurs also. The same applies to bottlenose dolphins off San Luis Pass, Texas (Maze and Würsig, 1999). Within the home range, habitat use varies with season, with shallow estuarine waters frequented during the summer and coastal waters and passes between barrier islands used during the winter (Wells and Scott, 1999 and refs. therein). However, behaviour may also vary among animals within the same area: Simoes-Lopez and Fabian (1999) found that in Laguna, southern Brazil 88.5 % of the individuals were resident and the rest were non-resident.

Dolphins living at the high latitude or cold water extremes of the species' range may migrate seasonally, as is the case along the Atlantic coast of the United States. It has been suggested that some dolphins may use seasonal home ranges joined by a travelling range: a 4-month cycle of occurrence of dolphins was observed in Golfo San Jose, Argentina (Wells and Scott, 1999 and refs. therein). Wood (1998) investigated a group of bottlenose dolphins in the coastal waters of Cornwall, UK in 1991. The dolphins demonstrated a seasonal residency pattern, spending the winter in southern Cornwall and moving further north-eastward during spring and summer. Residency was flexible with a number of individual dolphins using the region intermittently. The dolphins occupied a linear coastal range of 650 km. Within this range they repeatedly made long-distance journeys. The longest journey recorded covered 1,076 km and took 20 days.

Similar observations were recently also published by other authors: Wilson et al. (1997) report that members of a population of *Tursiops truncatus* resident in the Moray Firth off north-eastern Scotland were seen in all months of the year, but there were consistent seasonal fluctuations in the number of individuals present. Numbers were low in winter and spring and peaked in summer and autumn. Individuals exhibited rapid movements across the population's range. For instance, one individual was sighted at locations 190 km apart within a 5-day period.

Finally, in the Faroes, the bottlenose dolphins are observed all year round but with peaks in March and July-October (Bloch, 1998).

Barco et al. (1999) investigated patterns of abundance and distribution for coastal migratory *T. truncatus* that appear seasonally in the nearshore waters of Virginia Beach, Virginia. A profile analysis of variance revealed significant differences in local abundance and distribution throughout the year. Dolphin number was positively correlated with water temperature whereas the influence of prey distribution and abundance was unclear.

Defran et al. (1999) conducted boat-based photo-identification surveys of bottlenose dolphins from 1982 to 1989 in three discrete coastal study areas within the Southern California Bight: Santa Barbara, Orange County, and Ensenada (Mexico). A high proportion of dolphins photographed in Santa Barbara (88 %), Orange County (92 %), and Ensenada (88 %) were also photographed in San Diego. 58 % of these 207 dolphins exhibited back-and-forth movements between study areas, with no evidence of site fidelity to any particular region. Minimum range estimates were 50 and 470 km. Minimum travel-speed estimates were 11–47 km/d, and all dolphin schools sighted during the study were within 1 km of the shore. These data suggest that bottlenose dolphins within the Southern California Bight are highly mobile within a relatively narrow coastal zone and are presumably influenced by variation in food resources. Defran and Weller (1999) add that 1) the combination of regular dolphin occurrence, 2) low site fidelity by known individuals, and 3) the continuous increase in the rate at which new dolphins were identified indicates that numerous different individuals were visiting the study area across and within years. The open California coastline differs in habitat structure and prey distribution from more protected study areas where bottlenose dolphins display site fidelity, which may explain the observed intraspecific behavioural variability of this species.

Long distance movements have been reported from southern California in the early 1980s (Hansen and Defran, 1990) subsequently expanding the species' recent range more than 500 km northward in conjunction with an El Niño warm water event (Wells and Scott, 1999 and refs. therein). Following the El Niño, some dolphins remained in northern waters, while others returned to their previous range to the south. Würsig (1978, in Wells and Scott, 1999) reported a 600 km round-trip for several identifiable dolphins in Argentina. Tanaka (1987) reported that a satellite-tracked dolphin off Japan apparently travelled 604 km in 18 days along the Kuroshio Current.

Long-distance migrations are presumably also undertaken by offshore bottlenose dolphins, whose diet is comprised of highly migratory species of fish and squids. In a recent paper, Acevedo-Gutiérrez and Parker (2000) show that dolphin behaviour and spatial arrangement of their prey are closely linked. Off California, offshore bottlenose dolphins may extend their range northward to the area of the Northern Channel Islands, principally during summer and early fall. Off Peru, catches of the offshore form occur mostly during the summer, indicating some west-east migration (Reyes, 1991 and refs. therein).

Wells et al. (1999) tracked two rehabilitated adult male bottlenose dolphins with satellite- linked transmitters in 1997. "Rudy" was equipped in the Gulf of Mexico off central west Florida. He moved around Florida and northward to Cape Hatteras, NC, covering 2,050 km in 43 d. "Gulliver" was released off Cape Canaveral, FL. He moved 4,200 km in 47 d to a location north-east of the Virgin Islands. Gulliver swam through 5,000-m-deep waters 300 km offshore of the northern Caribbean islands, against the North Equatorial Current. These records expand the range and habitat previously reported for the offshore stock of bottlenose dolphins inhabiting the waters off the south-eastern United States and illustrate the difficulties of defining pelagic stocks.

6. Threats

Direct catch: Directed fisheries taking bottlenose dolphins have previously occurred around the Black Sea as well as in Mexico, Guatemala, Costa Rica, the West Indies, Venezuela, Sri Lanka, and off southern Africa, India and Peru. Drive fisheries for bottlenose and other dolphins were also reported from the Republic of China (Taiwan), but the numbers are not known. The species is taken in a drive fishery in the Faroe Islands which dates back to 1803, annual takes numbering from 1–308, often in mixed schools with long finned pilot whales (*Globicephala melas*) (Reyes, 1991 and refs. therein; Bloch, 1998).

In Peru, coastal fisheries still take *Tursiops* and other cetaceans for human consumption, using gill nets, purse seines, and harpoons and a similar fishery occurs in Sri Lanka (Wells and Scott, 1999 and refs. therein; Wells and Scott, 2002). Although direct killing has noticeably decreased since dolphin hunting was banned by law in 1996, around a thousand dolphins and other small whales are still falling victim annually to fishermen to supply bait meat for the shark fishery (2003, see "Mundo Azul" in "selected seb-sites"). The most significant take probably occurs off Japan, where bottlenose dolphins are killed for human consumption, bait and because of perceived competition with fisheries (Wells and Scott, 2002). Reported catches were: 230 in 1986; 1,813 in 1987 and 828 for 1988. (Reyes, 1991 and refs. therein).

Live captures: More than 530 Tursiops have been taken from US waters since the passage of the Marine Mammal Protection Act of 1972 (MMPA), particularly from the south-eastern USA. Present federal regulations limit the annual allowable take to less than 2% of the minimum estimated population in designated management areas, but no bottlenose dolphins have been collected in US waters since 1989. Some small scale live-capture fisheries continue in other countries (Wells and Scott, 1999 and refs. therein).

Incidental catch: Fisheries around the world account for incidental takes of bottlenose dolphins, but the present level of take remains unknown. Gillnet and purse-seine fisheries off Peru take an unknown number, but rough estimates are in the hundreds.

In the western Mediterranean incidental catches have been reported in trawl fisheries and in the driftnet swordfish fishery. Some tens are also taken in several other fisheries throughout the range.

Read et al. (2003) report that in North Caroliona interactions between dolphins and gill nets are common and that many of these interactions are food-based. Surprisingly, however, dolphins engaging in depredation do not appear to become entangled; instead it seems more likely entanglement occurs as a result of dolphins failing to change course around the net.

The estimated annual incidental mortality in the eastern tropical Pacific fishery for tuna ranges from 0 to almost 200, although it makes up only a very small fraction (less than 5 %) of the total small cetacean mortality in the fishery (Reyes, 1991 and refs. therein).

Incidental catches in Chinese fisheries reach several hundred per year (Yang et al. 1999), and a large incidental take of *Tursiops* has apparently occurred in the Taiwanese gill net fishery off Australia, with an annual mortality perhaps exceeding 2000 animals.

The use of shark nets to protect bathing beaches in South Africa and Australia has caused mortality as well. Dolphins were found with full stomachs, indicating recent feeding in the vicinity of the nets and there was a correlation of mortality rates with the direction of the prevailing current. Attempts to prevent the animals from entangling by incorporating active and passive devices in the net were not successful. The relatively high incidental catches of coastal dolphins off South Africa has prompted concerns that the take is not sustainable (Wells and Scott, 1999 and refs. therein).

According to Northridge (2003) a high proportion of the common dolphins that strand on the south coast of England in winter months bear evidence of fishery interactions. It is not known which fisheries are involved, but the number of stranded by-caught dolphins has raised concerns for their conservation status. Observers have monitored 149 days at sea since 2000, and have recorded 61 common dolphins taken in trawl nets. All of these animals were recorded in trawl tows targeted at bass. Preliminary mitigation trials using pingers were not effective, with no reduction in dolphin catch rate when pingers were deployed around the mouth of the trawl. Current work is focussed on using exclusion grids to allow dolphins to escape from the sleeve of the trawl.

Killing: *Tursiops* have been intentionally killed by fishermen in Japan and Hawaii and presumably such practices are found elsewhere in their range (Reyes, 1991). The Japanese drive fishery off Iki Island and the Kii Peninsula takes several hundred *Tursiops* annually to reduce the perceived competition with the commercial fishery for yellowtail, *Seriola* sp. (Wells and Scott, 1999 and refs. therein).

Pollution: Their worldwide distribution and great adaptability to diverse habitats make this species a good indicator of the quality of inshore marine ecosystems. There are reports of DDT, PCBs and heavy metals in bottlenose dolphins from the western Mediterranean, with higher levels of DDT and its metabolites (Reyes, 1991 and refs. therein).

Concentrations of polychlorinated biphenyls and dieldrin were measured in the blubber of South African specimens. First-born calves received 80 % of their mother's body burden of contaminant residues, perhaps leading to increased neonatal mortality. Accumulation of contaminants in tissues of males reached levels that theoretically could impair testosterone production and thus reduce reproductive ability (Wells and Scott, 1999, and refs. therein). Preliminary results of research by Lahvis et al. (1995) indicate that even relatively low levels of PCBs and DDT such as those found in the blood of Sarasota dolphins can result in a decline in immune system function.

Focardi et al. (2000) determined concentrations of tributyltin (TBT) and its degradation products, monobutyltin (MBT) and dibutyltin (DBT), in the liver and kidney of bottlenose dolphins found stranded along the western Italian and Greek coasts in the period 1992– 1994. Butyltin (BT) compounds were detected in almost all the samples analysed and were higher in the kidney than in the liver. BTs were found to be transferred from mother to fetus. Le et al. (1999) found higher butyltin concentrations in coastal as opposed to offshore *T. truncatus* from waters around Japan indicating land-based sources.

Frodello et al. (2000) determined mercury levels in various organs of specimens stranded along the Corsican coast between November 1993 and February 1996. In all cases, the liver appears to be the preferential organ for mercury accumulation, with concentrations as high as 4,250 µg Hg/g dw. Mercury levels found in livers may integrate mercury uptake having occurred during the whole life span of the animals.

Watanabe et al. (2000) determined concentrations of polychlorinated biphenyl congeners (PCBs) and organochlorine pesticides in the livers of bottlenose dolphins stranded on the coasts of Florida and found that hepatic concentrations were greater than those in the blubber of marine mammals of other regions, suggesting the presence of sources for these chemicals in the south-eastern US.

Tourism: Excessive and unregulated visiting of wild dolphins habituated to humans has raised concern in several areas, in particular in Europe (Reyes, 1991 and refs. therein). Nowacek et al. (2001) conducted focal animal behavioral observations during opportunistic and experimental boat approaches involving 33 well-known identifiable individual bottlenose dolphins off Sarasota, Florida. Dolphins had longer interbreath intervals (IBI) during boat approaches compared to control periods (no boats within 100 m) and the duration was inversely correlated with distance to the nearest boat in opportunistic observations. Dolphins decreased interanimal distance, changed heading, and increased swimming speed significantly more often in response to an approaching vessel than during control periods. These findings provide additional support for the need to consider disturbance in management plans for cetacean conservation (Yazdi, pers. comm.).

However, in Zanzibar waters, in the Western Indian Ocean, dolphin tours are organised from Kizimkazi, since local fishermen realised that their touristic value far exceeded that of using them as bait for sharks. As many as 2,000 tourists visit the dolphin site at Kizimkazi per month and dolphin-tourism is currently becoming a popular economic activity. Successful management of the dolphin-tourist trade will ensure continued visitors to the villages where dolphins are present and thus add income to these villages while contributing to management and conservation (Ali and Jiddawi, 1999).

Overfishing: Reduction of fish stocks by pollution or overfishing may affect dolphin populations such as those in the Black Sea, which has been severely depleted by intense hunting which continued until 1983 (Reyes, 1991 and refs. therein).

7. Remarks

The coastal nature of bottlenose dolphins makes them particularly susceptible to human impacts. Mass mortalities have led to increased awareness of the possible cumulative and synergistic effects of habitat alteration, pollution, fisheries, vessel traffic, offshore industrial activity, and other human activities (Wells and Scott, 1999).

The EU Habitats Directive 1992 (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) states that places within the natural range of small cetaceans important for biological factors essential to their life should be designated as a Special Area of Conservation. A recent investigation by Sykes et al. (2003) has highlighted that, in accordance with this legislation, the Bottlenose dolphins of the Dorset coast (England) require protection that is currently not provisioned.

One of the major threats are the incidental take throughout their range and the directed fishery for food in Japan and other countries. Concern has been expressed about the levels of commercial fisheries in the Black Sea, which eventually could reduce the amount of food available to the dolphins and ultimately become a source of competition and conflict (Reyes, 1991).

Since studies reveal that coastal bottlenose dolphins may move considerable distances within their home range, it should be expected that in several cases members of these populations may regularly cross international boundaries (i.e., the home range of the population in southern California may extend across the boundary with Mexico). Further studies on the source, dynamics and effects of pollutants on marine mammals as well as the extent of fishery interactions will benefit the conservation of this and other cetacean species (Reyes, 1991).

Peddemors (1999) summarises for the coast of Africa, south of 17°S, that more research emphasis should in future be placed on possible detrimental interactions due to overfishing of delphinid prey stocks. Increased commercial fishing pressure will inevitably increase interactions between the fishery and the affected delphinids. One of the inshore species considered to be vulnerable is the bottlenose dolphin in KwaZulu-Natal and Namibia. The bottlenose dolphin population in Namibia appears localised in its distribution and may therefore also be vulnerable to any future coastal development or commercial fishery expansions, while in KwaZulu-Natal they are subjected to ongoing incidental catches in shark nets, heavy pollution levels, habitat destruction and increased competition with fishermen for limited food resources.

For recommendations on South American stocks, see Hucke-Gaete (2000). See also general recommendations on Southeast Asian stocks (Perrin et al. 1996) in Appendix 1 and Appendix 2 respectively..

Only populations of *Tursiops truncatus* in the North and Baltic Seas, western Mediterranean and Black Sea are listed in Appendix II of CMS. However, because individuals of this species can either be resident, share a wide home range or migrate, it is suggested that all *Tursiops truncatus* populations should be included in app. II of CMS.

Range states include most nations of South, Central and North America, Africa, Europe, Oceania, Australia and Asia:

Ireland, the UK, The Netherlands, Belgium, France, Spain, Portugal, Morocco, Mauretania, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameron, Gabon, Rep. Congo, Dem. Rep. Congo, Angola, Namibia, Rep. South Africa, Mozambique, Madagascar, Tansania, Kenia, Somalia, Djibouti, Yemen, Sudan, Egypt, Saudi-Arabia, Oman, Abu-Dabi, Katar, Bahrain, Iraq, Iran, Pakistan, India, Bangladesh, Sri Lanka, Myanmar, Thailand, Malaysia, Indonesia, Australia, New Zealand, Papua New Guinea, The Pihlippines, Cambodia, Vietnam, China, North and South Korea, Japan, Russia, the USA, Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, Chile, Argentina, Uruguay, Brasil, French-Guyana, Surinam, Guyana, Venezuela, Santo Domingo, Haiti, Cuba, Belize, Jamaica, the Bahamas.

The species is listed as "Data Deficient" by the IUCN.

The bottlenose dolphin is protected by national legislation in a number of countries, usually through general cetacean protection provisions.

Kindly reviewed by Dorete Bloch, Museum of Natural History, Thorshavn, Faroe Islands.

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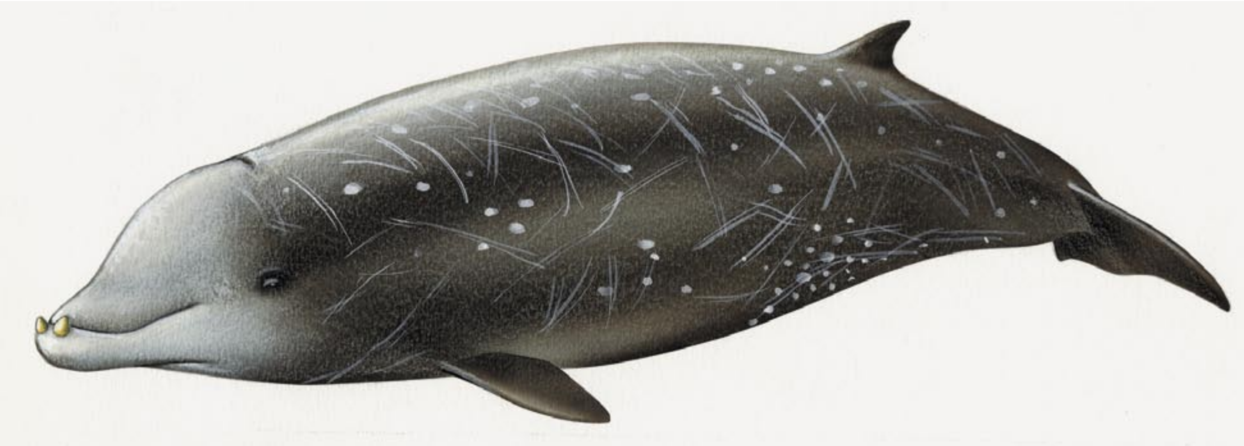
5.71 Ziphius cavirostris (G. Cuvier, 1823)

English: Cuvier´s beaked whale, Goosebeak whale
German: Cuvier-Schnabelwal
Spanish: Ziphio de Cuvier
French: Ziphius



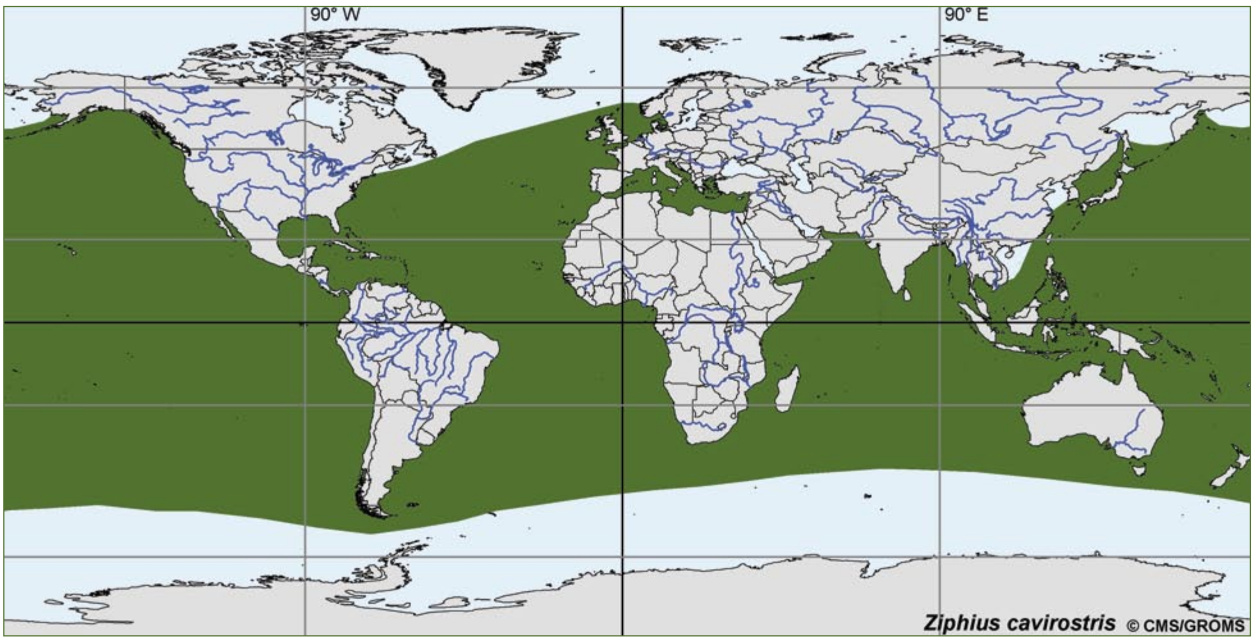
Drawing of Ziphius cavirostris
© Wurtz-Artescienza.

1. Description

The general body shape of *Z. cavirostris* is similar to that of other beaked whales: rather robust, cigar-shaped, small falcate dorsal fin, relatively small flippers. The flippers can be tucked into a slight depression along the body wall. The flukes are proportionately large, as in other ziphiids. The head is rather blunt in profile with a small, poorly defined rostrum that grades into the gently sloping melon. Pigmentation is dark slate grey over most of the body, with a distinctively white head in males and a slight lightening of the skin in females. Light oval patches attributed to cookie-cutter sharks (*Isistius* spec.) and linear marks due to intraspecific fighting between males (which have two apical teeth) are common. The largest adult male was 7 m long (Heyning, 2002).

2. Distribution

All temperate and tropical waters around the world, north to Massachusetts, the Shetland Islands, the Mediterranean, Honshu, the Aleutian Islands, and the northern Gulf of Alaska; south to Tierra del Fuego, Cape Province in South Africa, Tasmania, South Island



Distribution of Ziphius cavirostris: world-wide distribution in tropical, subtropical, and temperate waters (mod. from Carwardine, 1995; © CMS/GROMS).

of New Zealand, and the Chatham Islands (Rice, 1998).

Cuvier's beaked whales may have the most extensive range and may be one of the most abundant of any beaked whale species. They are fairly common in certain areas, such as the eastern tropical Pacific (Jefferson et al. 1993; Heyning, 1989). However, they are generally inconspicuous and rarely seen at sea. They are known mainly from strandings (see Heyning, 1989, for a detailed list) and are found stranded more often than most other beaked whales. The species is absent only from polar waters (in both hemispheres; Carwardine, 1995). Geographical variation has not been analysed (Rice, 1998).

3. Population size

Strandings of *Z. cavirostris* are the most numerous of all beaked whales, indicating that they are probably not as rare as originally thought. Observations reveal that the blow of *Z. cavirostris* is low, diffuse and directed forward, making sightings more difficult, and there is some evidence that they avoid vessels by diving. These two facts may be the reason for the relatively few sightings made at sea (Heyning, 1989).

Waring et al. (2001) provide a stock assessment for all beaked whales in the western North Atlantic including *Z. cavirostris* and *Mesoplodon* spec. and come up with a minimum figure of 2,400 animals.

4. Biology and Behaviour

Habitat: Off Japan, whaling records indicate that *Z. cavirostris* is most commonly found in waters deeper than 1000 m (Heyning, 1989 and refs. therein). *Z. cavirostris* is known around many oceanic islands, and relatively common in enclosed seas such as the Mediterranean and Sea of Japan. It is a year-round resident in Hawaiian waters and several other areas. It is rarely found close to mainland shores, except in submarine canyons or in areas where the continental shelf is narrow and coastal waters are deep (Carwardine, 1995) and is mostly a pelagic species which appears to be confined by the 10°C isotherm and the 1000-m bathymetric contour (Houston, 1991; Robineau and di Natale,1995).

Behaviour: They normally avoid boats but are occasionally inquisitive and approachable, especially around Hawaii. Breaching has been observed, though it is probably rare. (Carwardine, 1995). Dives of up to 40 minutes have been documented.

Schooling: Cuvier's beaked whales are found mostly in small groups of 2 to 7, but are not uncommonly seen alone (Jefferson et al. 1993). Most of our knowledge of the various ziphiid species comes from stranded individuals or animals taken in whaling operations (Willis and Baird, 1998).

Food: Cuvier's beaked whales, like all beaked whales, appear to prefer deep water; they feed mostly on deep sea squid, but also take fish and some crustaceans (Jefferson et al. 1993). Blanco and Raga (2000) investigated the stomach contents of two Cuvier's beaked whales stranded on the western Mediterranean coast. Food consisted exclusively of hard cephalopod remains, which agrees with the offshore and deep diving behaviour of *Z. cavirostris*.

Nishiwaki and Oguro (1972, in Heyning, 1989) found that stomach contents from *Z. cavirostris* caught off Japan varied consistently with a predominance of squid from animals taken in waters slightly under 1000 m in depth, with fish being the most abundant prey item found in animals taken in deeper waters. *Z. cavirostris* could thus be somewhat opportunistic in its feeding habits. It is interesting to note that most of the prey items found are either open ocean, mesopelagic, or deep-water benthic organisms, concurring with the idea that *Z. cavirostris* is an offshore, deep-diving species (Heyning, 1989). For details on beaked whale diet and niche separation see also the account on Mesoplodont whales (page 154).

5. Migration

In the north-eastern Pacific from Alaska to Baja California, Mitchell (1968, in Heyning, 1989) summarised the stranding record to date and found no obvious pattern of seasonality to the strandings. Robineau and di Natale (1995) summarise that there are seasonal differences in strandings recorded from the French coast with peaks in winter and spring, whereas strandings in the Mediterranean seem to peak in winter. Carwardine (1995) summarises that there is no information on migrations and nothing is reported in the more recent literature.

6. Threats

Direct catches: In the past, there have been a few small cetacean fisheries that have taken Ziphius. In the Japanese Berardius fishery, *Z. cavirostris* have been taken on an opportunistic basis with catches varying from 3 to 35 animals taken yearly. Although the *Berardius* fishery still continues, there have been no takes of *Z. cavirostris* in recent years. The small cetacean fishery in the Lesser Antilles also occasionally took *Z. cavirostris* (Heyning, 1989, and refs. therein; Jefferson et al. 1993).

Incidental catches: Mignucci et al. (1999) conducted an assessment of cetacean strandings in waters off Puerto Rico, the United States and the British Virgin Islands to identify the factors associated with reported mortality events between 1867 and 1995. The bottlenose dolphin (*Tursiops truncatus*) was the species most commonly found stranded, followed by Cuvier's beaked whale. An increase in the number of strandings is evident over the past 20 years, averaging 63.1 % per year. Between 1990 and 1995, the average number of cases per year increased from 2.1 to 8.2. The seasonal pattern of strandings was not found to be uniform, with a high number of strandings occurring in the winter and spring. The most common human-related cause categories observed were entanglement and accidental captures, followed by animals being shot or speared. Mora Pinto et al. (1995) report on by-catches from Colombian fisheries. Notarbartolo (1990) reports on by-catches in the Italian swordfish fishery. By-catches in the western North Atlantic are very low, with one animal reported between 1994 and 1998 (Waring et al. 2001).

Pollution: Analysis of tissues from a male from New Zealand found no traces of lead or organophosphates, but the following levels of potential toxins were noted: DDE, 1.2-mg/kg; DDT, 1.2-mg/kg; DDD, 0.25-mg/kg; and mercury, 1.9-mg/kg (Fordyce et al. 1979, in Heyning, 1989). Colin McLeod (2002, pers. comm.) did a review of stomach contents in beaked whales and found that at least 50 % of Cuvier's beaked whales stranding on European coasts contain some plastics, while it is much rarer in northern bottlenose whales and Mesoplodon species. One possibility for this is that floating plastic sheets and bags either at the surface or at depth will act as fish attractors, providing shelter from predatory fish. Beaked whales being suction feeders, may then ingest the bag/plastic sheeting while 'hoovering' up actual prey which are hanging around close to the floating debris. For these suction feeders there would be little chance to "select" prey based on taste or feel as it will be in the mouth and swallowed before it is noticed.

Acoustic pollution: Frantzis (1998) found that a mass-stranding of 12 Cuvier's beaked whales in the Ionian Sea (Mediterranean) coincided closely in time and location with military tests of an acoustic system for submarine detection being carried out by the North Atlantic Treaty Organisation (NATO). Although pure coincidence cannot be excluded, it seems improbable that the two events were independent. According to Balcomb (pers. comm.), NATO and the US Naval Undersea Warfare Center have calculated the resonance frequency of airspaces in Cuvier's beaked whales to be about 290 Hz at 500 meters depth, which is almost precisely the middle frequency of the sonar systems that were tested. Whale mortality during tests could therefore be due to resonance phenomena in the whales' cranial airspaces that are tearing apart delicate tissues around the brains and ears.

The connection between military tests and strandings is supported by the stranding of at least 12 specimens during a naval exercise off The Bahamas in March 2000 (Waring et al. 2001). Another 7 *Z. cavirostris* died in September 2002 during a naval exercise conducted around Gran Canaria, Spain (Vidal Martin, pers. comm.). High intensity Low Frequency Active Sonar (LFAS) was used by US and NATO vessels in these areas, respectively, which led to stranding of other species as well, including *M. densirostris* (see page 165).

Degollada et al. (2003) performed necropsies on ten carcasses in Gran Canaria between 24 and 72-h postmortem following standard procedures. The most remarkable features were inner ear hemorrhages and edema starting in the VIIIth cranial nerve and extending into the spiral ganglion and the cochlear channels. In addition, inner ear structural damages were found. These findings are consistent with the lesions observed in other organs, in particular the brain, confirming an acoustically induced trauma as the only non-discarded cause of death.

7. Remarks

Very little is known about this species. However, mass strandings after military sonar tests are a matter of concern and should be further investigated. Due to a lack of abundance data, the effects of by-catches in fisheries cannot be evaluated. Listed by the IUCN as "Data Deficient" and not listed by CMS. More information is clearly needed.

Ziphius also occurs in southern South America, therefore the recommendations iterated by the scientific committee of CMS for small cetaceans in that area (Hucke-Gaete, 2000) also apply. For recommendations concerning south-east Asian stocks, see Perrin et al. (1996) in Appendix 1 and Appendix 2 respectively.

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6 APPENDIX 1:
Recommendation on Cetaceans in Southern South America (from Hucke-Gaete 2000)

In a recent review on the conservation status of small cetaceans in southern South America, the authors recommended:

Fisheries interactions

- Mathematical modelling of the effects of fishery interactions (both operational and ecological) on cetacean populations.
- Further identification of conflict areas between small cetaceans and fisheries.
- Collection of good field data on basic ecosystem interactions.
- Establishment of monitoring studies to assess the magnitude of incidental and directed mortalities of small cetaceans.
- Determination of the impact of marine mammals on fisheries, particularly artisanal fishing activities. Solutions are urgently needed, like the ones currently under experimentation in the U.S. concerning bycatch in gillnets, which are having encouraging results (see IWC, 1996).

Biological studies

- Distribution and abundance of dolphin and porpoise populations and their fluctuations.
- Stock identity of sub-populations by means of morphological and molecular genetic studies.
- Natural history studies: sex and age structure, age at maturity, pregnancy rate and diet to assess possible effects of fisheries on populations.
- Possible effects of El Niño Southern Oscillation (ENSO) phenomenon over small cetacean populations in relation to their habitat and prey items.

Political and private support

- Establishment of a collaborative network, under the sponsorship of the CMS, among scientists of the countries involved. This network will function as a discussion forum on how to cover high priority research areas, solve specific problems, and achieve and encourage the training of young scientists (courses, exchanges, and scholarships in ongoing research programmes). To be able to implement this, the authors urge the establishment of a small conservation fund for meetings and priority short term research.
- Regional reassessment of marine mammal species' conservation status by every government in close collaboration with scientists, in order to compare this status with the one informed by IUCN, and establish a local conservation regime.
- Further the adoption of precautionary principles by each government in the administration of fishing and faunal resources.
- Involve local, regional and national authorities in workshops to make them more willing to accept different points of view in the protection of marine resources.
- involve the private sector in the solution of conservation problems.
- Urge the creation of Marine Protected Areas (Reserves) with an effective management by each country, preferably following guidelines prepared by Kelleher & Kenchington (1991) for the IUCN.

The implementation of inspectors (perhaps ad honorem) who must be authorized to enforce national regulations concerning marine mammal protection, should be assessed by each government.

Source

HUCKE-GAETE R, ed. (2000) Review on the conservation status of small cetaceans in southern South America. UNEP/CMS Secretariat, Bonn, Germany, 24 pp.

7 APPENDIX 2: Conservation of Small Cetaceans in South-East Asia (from Perrin et al. 1996)

The following list of recommendations was developed during discussions at the Workshop on the biology and conservation of small cetaceans and dugongs of south-east Asia (Perrin et al. 1996).

Incidental captures

Incidental captures in fisheries are a major source of mortality of small cetaceans throughout Southeast Asia. There are few quantitative data on the species caught or the numbers of animals killed. In some countries, the introduction of laws prohibiting the incidental capture of marine mammals has increased the difficulty in obtaining information on such takes. The Workshop recommended that:

- studies on abundance and stock structure within the region be carried out using appropriate methodologies;

- all countries give high priority to research on the impact of the incidental catches of marine mammals in their waters;

- laws prohibiting the incidental capture of marine mammals be amended so that fishermen who present specimens or data for scientific research are immune from prosecution;

- local people, institutions and governments be encouraged to participate directly in the planning and implementation of research on marine mammals and other aquatic resources and the resulting management and conservation programmes.

Documentation of marine mammal resources

Because it is very difficult to halt a major development once planning has reached an advanced stage, it would be more effective to alert a developer, the government or the local people to a potential problem prior to this stage. The Workshop therefore recommended that each country give high priority to the identification of coastal and riverine areas which support significant population of marine mammals, such as feeding and calving areas, and to the wide dissemination of this information in an effective format (e.g., GIS, coastal resource atlases, use of local language).

Training of national scientists

Successful marine mammal research programmes in Southeast Asia will require professionally trained nationals. Successful programmes have been developed to train the nationals of several countries, especially Thailand and the Philippines. Expertise in marine mammal research is less well developed in most other countries in the region with the exception of Australia. The Workshop recommended that:

- UNEP, perhaps in cooperation with partners from the EGO and NGO community, sponsor regional training workshops in the methodologies required for marine mammal research such as those organised in South America (1986-87) and Africa (1992);

- countries with established expertise assist with the postgraduate training of scientists from the region.

International co-operation

Marine mammals do not recognize political boundaries, and research to support their conservation often requires international cooperation. The Workshop recommended that countries sharing contiguous aquatic environments supporting significant marine mammal populations endeavour to develop cooperative research programmes to provide the information required to develop effective management policies.

When international agencies fund large-scale assessments of natural resources in a region, it may be cost-effective to include marine mammal surveys in such projects. The Workshop recommended that:

- when UNEP is aware of such opportunities it suggest (in consultation with regional experts) that marine mammal surveys be considered in the planning of the project;

- the GEF Yellow Sea Project consider including cetacean surveys with the assistance of appropriate technical expertise from other countries, e.g. Japan.

There are several intergovernmental sources of funding for marine mammal research, including UNEP Regional Seas Programme, ASEAN Biodiversity Programme, and Biodiversity Convention Funding. The Workshop noted that the IUCN Cetacean Action Plan projects in Eastern and Southern Asia are being implemented largely through Ocean Park Conservation Foundation (OPCF) and its partners, e.g. Whale and Dolphin Conservation Society, WWF, and David Shepherd Foundation. The Workshop recommended that Governments in the region explore, either multilaterally or bilaterally, the development of a cooperative approach to inter-governmental funding and sourcing agencies.

Source:

PERRIN WF, DOLAR MLL, ALAVA MNR (1996) Report of the workshop on the biology and conservation of small cetaceans and dugongs of Southeast Asia. East Asia Seas Action Plan. UNEP(W)/EAS WG. 1/2, Bangkok, Thailand. 101 pp.

8 Selected Web-sites

Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
http://www.ascobans.org

Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
http://www.accobams.org

Alaska Sea Grant Education
http://www.uaf.edu/seagrant/marine-ed/mm/beluga.html

Alfred-Wegener-Institute for Polar and Marine Research (AWI-Bremerhaven)
http://www.awi-bremerhaven.de

American Society of International Law – Wildlife Interest Group: resources relevant to small cetaceans
http://www.internationalwildlifelaw.org

Andora: I cetacei del Mediterraneo (in Italian)
http://www.andora.it/whale/medit.htm

Arctic Studies Center
http://www.mnh.si.edu/arctic/html/tek.html

Artescienza: Scientific Art (in italian)
http://www.artescienza.org

Azorean whale whatching base (in English)
http://www.espacotalassa.com

Aquaheart, Japan (in Japanese)
http://www.gem.hi-ho.ne.jp/aquaheart/aqua08.shtml

Baleines etc. (Marsouins, dauphins et baleines) in French
http://baleines.etc.free.fr/index1.htm

Biology of cetaceans at University of Genova (in Italian)
http://www.biologia.unige.it/wurtz/index.html

Canadian museum of nature
http://www.nature.ca

Canadian whaling report
http://www.cmeps.org

Care and preservation of marine wildlife
http://www.seafriends.org.nz

Cetacea: whales, dolphins and porpoises
http://www.cetacea.org/index.htm

CSI: Cetacean Society International
http://csiwhalesalive.org/index.html

CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora
http://www.cites.org/

CMS: Convention on Migratory Species Homepage
http://www.wcmc.org.uk/cms/

Conservation Breeding Specialist Group
http://cbsg.org

Danish Mammal Atlas: Dansk Pattedyratlas (in Danish)
http://www.pattedyr.net

Dolphin ring
http://www.wcug.wwu.edu/~narf/dolp/

Don McMichael, Marine Artist
http://www.donmcmichael.com/originals2.htm

European Cetacean Society
http://web.inter.nl.net/users/J.W.Broekema/ecs/

Fishbase.org: all the fishes in the world
http://fishbase.org

GROMS: Global register of migratory species
http://www.groms.de/

INBIO: Instituto Nacional de Biodiversidad, Costa Rica (Marine Mammals, in spanish)
http://www.inbio.ac.cr/es/default.html

Innerspace Visions: professional pictures and photographs
http://www.seapics.com/

IUCN: International Union for the Conservation of Nature Red List
http://www.redlist.org/

Jaap's Marine Mammal Pages
http://ourworld.compuserve.com/homepages/jaap/

Leibniz-Institute of Marine Science IFM-GEOMAR
http://www.ifm-geomar.de

Metridium fields: underwater video-clips and photographs
http://www.metridium.com

Mundo azul: Peruvian dolphin protection
http://www.peru.com/mundoazul/protejamos_delfines/index.asp

NAMMCO - North Atlantic Marine Mammal Commission
http://www.nammco.no/

National Science Museum, Tokyo, Japan
http://www.kahaku.go.jp/english/index.html

Normandy marine mammals
http://perso.wanadoo.fr/gecc/

North West Territories Protected Area Strategy
http://www.gov.nt.ca/RWED/pas/index.htm

Oregon coast aquarium, Newport
http://www.aquarium.org

Paraty / Projecto Golfinhos (in portuguese)
http://www.paraty.com.br/Golfinho.asp

Pelagos cetacean research institute, Greece
http://www.pelagosinstitute.gr

Research Bibliography on Small Cetaceans (updated bi-monthly)
http://www.jiwlp.com/cgi/bibliog.cgi

Sea Mammal Research Unit, University of St. Andrews, Scotland
http://smub.st-and.ac.uk

The oceans pages (in German)
http://www.ozeane.de

The Porpoise Page
http://www.theporpoisepage.com

Underwater bioacoustics and marine mammals
http://www.unipv.it/cibra

University of Michigan Museum of Zoology animal diversity web
http://animaldiversity.ummz.umich.edu/index.html

U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2001
http://www.nefsc.noaa.gov/nefsc/publications/tm/tm168/index.htm

Whales in Danmark (in Danish)
http://www.hvaler.dk

Whales, Dolphins and Men (in German)
http://www.cetacea.de

Whales on the net
http://www.whales.org.au/home.html

Whale Research Org (Video footage of *Mesoplodon densirostris*)
http://www.whaleresearch.org/main_beaked.htm

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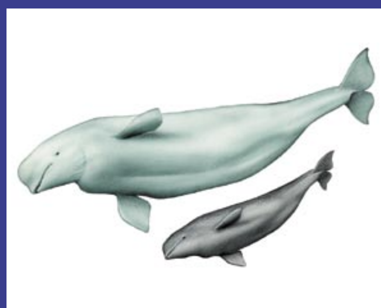
Illustrations on the cover (from left to right):
Front: Cephalorhynchus eutropia; Orcinus orca; Grampus griseus;
Tursiops truncatus; Stenella frontalis.
Back: Cephalorhynchus hectori; Monodon monoceros; Delphinapterus leucas.



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