NOAA Technical Memorandum
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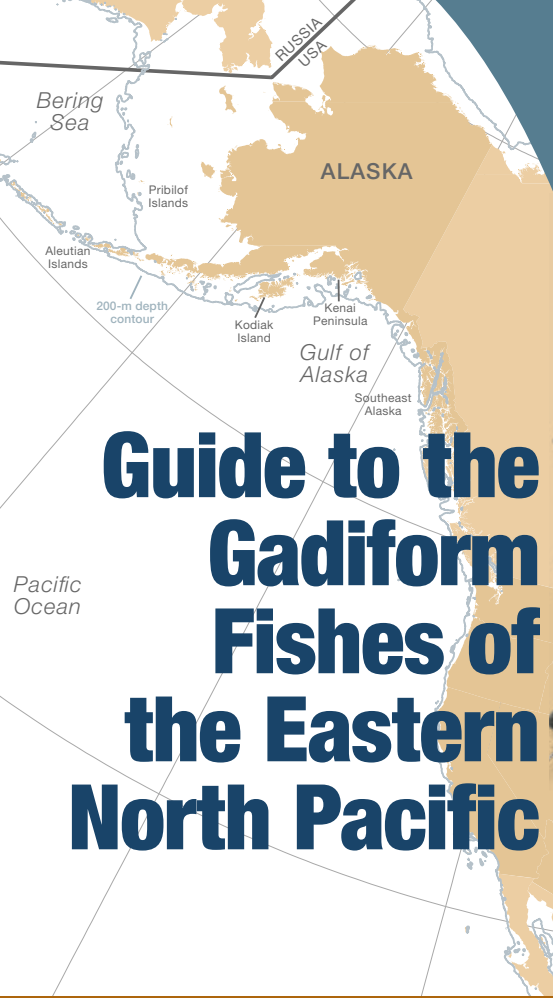
Guide to the Gadiform Fishes of the Eastern North Pacific



CODS GRENADIERS HAKES MORIDS CODLINGS

NOAA Technical Memorandum NMFS

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Guide to the Gadiform Fishes of the Eastern North Pacific

Cods Grenadiers Hakes Morids Codlings

authors

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Using This Guide

The guide includes dichotomous keys to the gadiform families and species of the eastern North Pacific. The first step for guide users is to become familiar with the terminology and standard characters used in the key by reviewing the diagrams identifying important fish structures and the glossary of terms. Next, begin with the key to families and identify the likely family the species belongs to, then proceed to the individual family key and work through each couplet from the beginning until the species has been identified. Finally, refer to the individual accounts, which provide detailed information, photos, distinguishing characters, and data on size and depth distribution to assist in confirming species identifications. Also included in this guide are histograms comparing maximum lengths, latitudinal ranges, and depth ranges for all species. These histograms will serve as useful quick comparative references to help determine the species expected in local study areas.

Introduction

Encompassing the species commonly known as cods, the order Gadiformes comprises nine families of about 555 species around the world. In the eastern North Pacific, five families are represented: the true cods (Gadidae), grenadiers (Macrouridae), codlings (Moridae), hakes (Merlucciidae), and arrowtails (Melanonidae). Members of this order are among the most familiar fishes of the North Pacific and they support some of the largest fisheries in the world. Although worldwide a few gadiforms are occasionally found in freshwater, with the exception of a single freshwater species, the burbot (*Lota lota*), all species in the eastern North Pacific are exclusively marine. They occupy a broad range of habitats from shallow arctic waters to some of the deepest waters of the North Pacific.

This guide describes the gadiforms found in the marine waters of the eastern North Pacific and Arctic oceans adjacent to North America from the Alaska arctic to the U.S.-Mexico border, as well as the burbot, the only gadiform species found in freshwater. This guide treats members of the order in the region, including both common and rarely observed species. Although other species of North Pacific fishes have traditionally been referred to as "cods," they are not true cods (Gadiformes). These include widely known species such as the black cod or sablefish of the family Anoplopomatidae, the lingcod of the family Hexagrammidae, and the rockcods (rockfishes) of the family Scorpaenidae. These species are not gadiforms and are not included in this guide.

This guide is designed to be used by researchers, students, and industry professionals to help identify these abundant, common, and commercially important species. The keys to families and individual species lead to species accounts that include a photograph, distribution map, size range, depth range, brief life history information, and comparisons with similar species.

Diversity and Natural History

The gadiforms of the eastern North Pacific include species of five families of fishes: the Gadidae, Macrouridae, Moridae, Merlucciidae, and the Melanonidae. The family Gadidae, or true cods, contains the most well-recognized species of the order. Of the 25 gadid species known worldwide, seven species in six genera are known from the eastern North Pacific, including the exclusively freshwater burbot. All marine gadids (cods) are found in relatively shallow subtidal waters associated with the continental shelf. Recent genetic evidence has suggested that *Theragra* is a synonym of *Gadus* and we follow this for the walleye pollock, now recognized as *Gadus chalcogrammus.* We consider two Arctic species, *Arctogadus borisovi* and *Gadus ogac*, as synonymous with *Arctogadus glacialis* and *Gadus macrocephalus*, respectively.

The 14 eastern North Pacific species of the family Macrouridae, or grenadiers, are all strictly marine and primarily deep water fishes found on the margins of the continental shelf, along the continental slope, to the abyssal plain. The morphologically distinct *Albatrossia* has recently been placed in the genus *Coryphaenoides,* however, we retain the former genus for this species. We recognize *Coryphaenoides leptolepis* from our area as synonymous with *C. liocephalus.* An additional rare deepwater species, *Echinomacrurus occidentalis*, has been recorded once from this region, but the specimen could not be located, and therefore the species is not included in this guide. The closely related Moridae, or codlings, are also strictly marine and are found at intermediate depths on the upper continental slope. The five species in five genera are relatively small as adults. The family Merlucciidae, the hakes, are known from two hake species: one in the northern Pacific and the other in the central Pacific. These species are similar in habitats and morphology, forming large schools over the outer edges of the continental shelf. The two species, *Merluccius productus* and *M. angustimanus,* in our area have been synonymized by some authors, however we recognize both species. The single rare northern species of the Melanonidae, the arrowtail, *Melanonus zugmayeri*, is a deep pelagic species known from only a few specimens.

Fisheries

Several species of the families Gadidae and Merlucciidae aggregate in large schools over the continental shelf in relatively shallow waters and are readily accessible to fishing fleets. These species are generally large and have life histories that allow substantial fishing effort when well managed. They tend to mature relatively early and are highly fecund, producing large numbers of eggs and larvae. As a result they are a food source for many predatory fishes and are an important component of the ecosystems they inhabit. Three of the most important commercial species in U.S. waters are the walleye pollock, *Gadus chalcogrammus*, Pacific cod, *Gadus macrocephalus,* and Pacific hake, *Merluccius productus*. Although many other species of the family Gadidae are abundant and accessible to fisheries, they are much smaller and are rarely targeted.

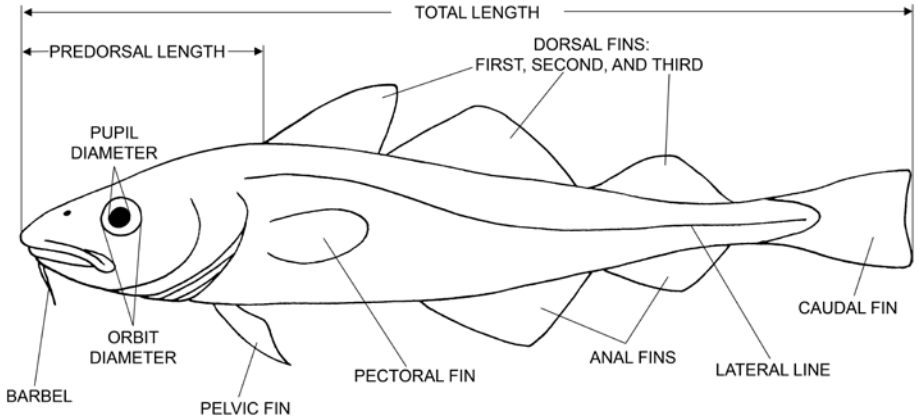
Among the Macrouridae, most species occupy the continental slopes and abyssal plains and are small with poor quality flesh or are not abundant, which precludes them as fisheries targets. However, a single species, the Pacific grenadier, *Coryphaenoides acrolepis*, is relatively abundant in deep waters and has been the target of moderate fisheries along the Oregon and Washington coasts, and its palatable flesh is marketed as fresh fillets.

Species of the other gadid families, Moridae and Melanonidae, are generally less common and small. They occur primarily in deep slope habitats and are not significant targets of commercial fisheries.

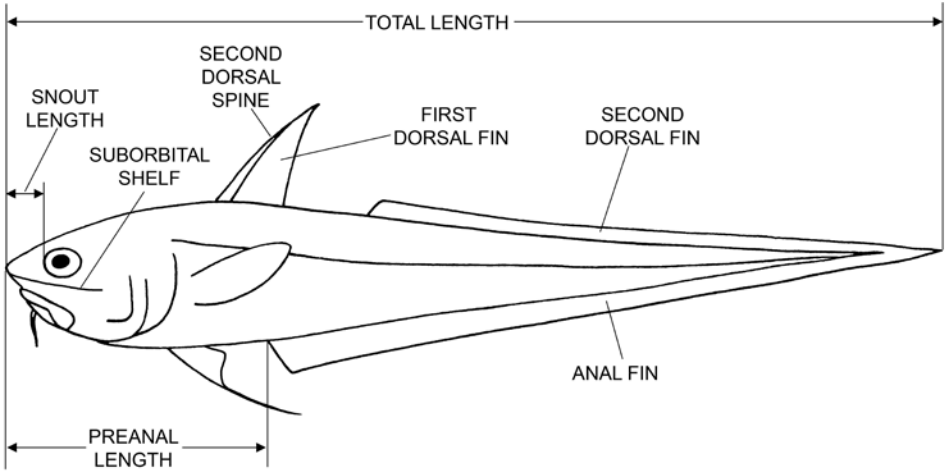
Primary sources

Cohen et al. 1990, Iwamoto and Stein 1974, Mecklenburg et al. 2002.

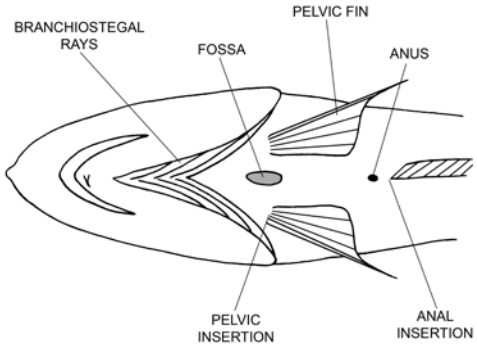
Cod Outline



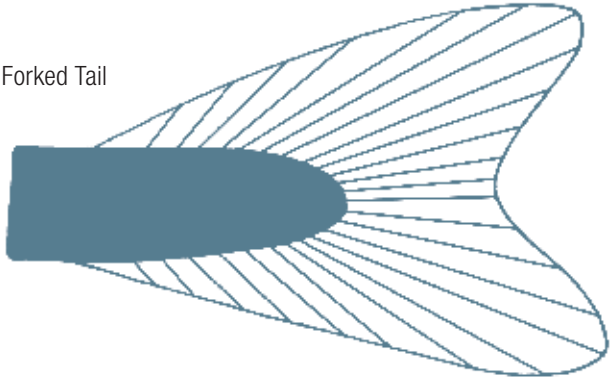
Grenadier Outline



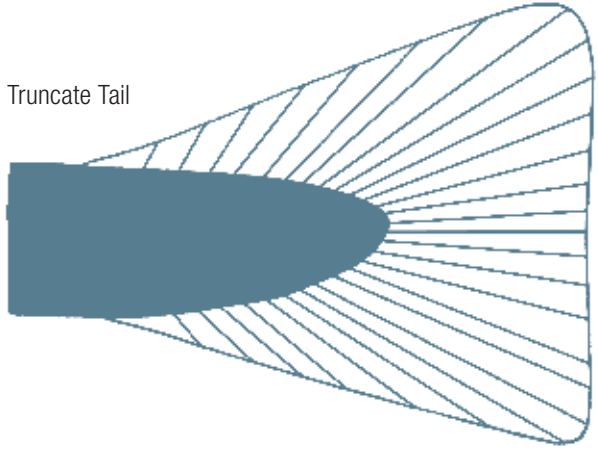
Grenadier Ventral



Forked Tail

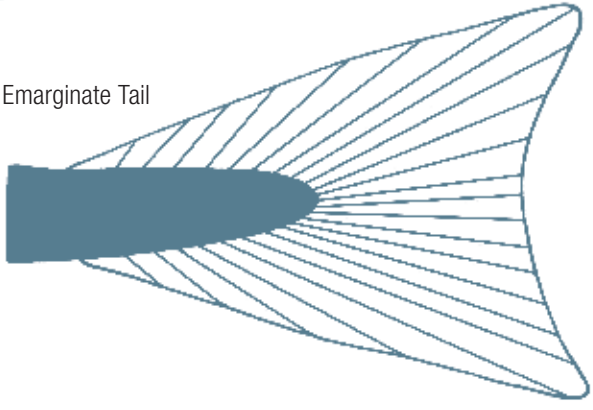


Truncate Tail

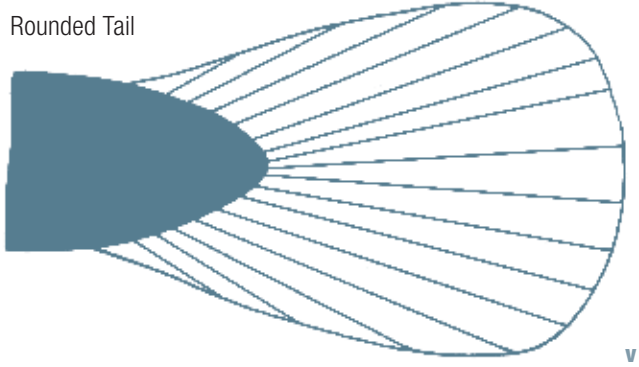


Pointed Tail

Emarginate Tail



Rounded Tail



Key to Gadiform Fishes of the Eastern North Pacific

1a.	Second dorsal fin and anal fin continuous with caudal fin	**Macrouridae**
1b.	Dorsal and anal fins separate from caudal fin	2
2a.	One dorsal and one anal fin, each with long base	*Melanonus zugmayeri*
2b.	Two or three separate dorsal fins	3
3a.	Three dorsal fins and two anal fins; all fins with similarly short bases	**Gadidae** (in part)
3b.	Two dorsal fins and one anal fin; second dorsal and anal fin each with long base	4
4a.	Pelvic fin reaching first dorsal fin or farther posterior; caudal fin truncate, emarginate, or forked; nasal tubes reduced or absent	5
4b.	Pelvic fin falling far short of first dorsal-fin origin; caudal fin rounded; nasal tubes distinct	**Gadidae** (in part)
5a.	Second dorsal fin deeply notched about mid-length	**Merlucciidae**
5b.	Second dorsal-fin margin straight, without notch	**Moridae**

FAMILY MACROURIDAE

1a.	Seven branchiostegal rays; several scale rows between anus and anal-fin insertion	2
1b.	Six branchiostegal rays; scales absent between anus and anal-fin insertion	6
2a.	Scales rough and adherent; second dorsal -fin spine moderately to roughly serrated	3
2b.	Scales weak and deciduous; second dorsal-fin spine smooth or weakly serrated	4
3a.	Pelvic fin rays 11–12; gill rakers on first arch 7–9	*Nezumia kensmithi*
3b.	Pelvic fin rays 9–10; gill rakers on first arch 10–11	*Nezumia stelgidolepis*

4a.	Anus anterior to first dorsal-fin origin; chin barbel absent; pyloric caeca <20	*Mesobius berryi*
4b.	Anus under first dorsal-fin base; chin barbel present; pyloric caeca ≥20	5
5a.	Fossa large, near pelvic-fin insertion; pyloric caeca >50	*Malacocephalus laevis*
5b.	Fossa inconspicuous, midway between pelvic fins and anal fin; pyloric caeca 20–40	*Nezumia liolepis*
6a.	Fossa near pelvic-fin base; 1–3 scale rows between anus and anal-fin insertion; stout lateral scales on head forming distinct ridges	*Coelorinchus scaphopsis*
6b.	Fossa absent; no scales between anus and anal-fin insertion; lateral scales on head not forming distinct ridges	7
7a.	Upper jaw extending beyond orbit; otolith elongate, comb-shaped; swim bladder shorter than orbit; soft dorsal + pelvic rays ≤17	*Albatrossia pectoralis*
7b.	Upper jaw not extending beyond orbit; otolith rounded, disk-shaped; swim bladder longer than orbit; soft first dorsal + pelvic rays ≥17	8
8a.	First ray of pelvic fin elongate, reaching to mid-body or beyond; second ray of pelvic fin reaching beyond anus	*Coryphaenoides longifilis*
8b.	First ray of pelvic fin somewhat elongate, not reaching mid-body; second ray of pelvic fin not reaching anus	9
9a.	Snout blunt, not much beyond mouth; single row of adherent scales along dorsal edge of snout	*Coryphaenoides leptolepis*
9b.	Snout pointed, protruding beyond mouth; scales on snout not as above	10
10a.	Single scute on end of snout; scales deciduous and body easily denuded; body color light brown, gray, or white	11
10b.	Snout without single scute; scales somewhat adherent and retained; body color black, gray, or brown	12

11a.	Relatively broad suborbital area with 2–3 adherent rows of scales; scales brownish; pyloric caeca elongate, about 10	*Coryphaenoides filifer*
11b.	Suborbital area narrow, without scales; scales grayish; pyloric caeca short, 5–8	*Coryphaenoides cinereus*
12a.	Snout edge with rows of scutes; pelvic-fin rays typically 8; lips not papillated; anal-fin origin posterior to second dorsal-fin origin	*Coryphaenoides acrolepis*
12b.	Snout edge without rows of scutes, head evenly scaled; pelvic-fin rays 10 or more; lips large, papillated; anal-fin origin anterior to second dorsal-fin origin	13
13a.	Scales on suborbital shelf evenly distributed in 4–5 rows	*Coryphaenoides armatus*
13b.	Scales on suborbital shelf in 2 distinct rows	*Coryphaenoides yaquinae*

FAMILY GADIDAE

1a.	Two dorsal fins and one anal fin, second dorsal fin and anal fin greatly elongate, originating about mid body; nasal tube present; caudal fin rounded	*Lota lota*
1b.	Three dorsal fins and two anal fins, none greatly elongate; nasal tube absent; caudal fin emarginate, forked, or truncate	2
2a.	Chin barbel long, equal to or longer than orbit; upper jaw longer than lower jaw; pectoral fin not reaching beyond first dorsal fin	3
2b.	Chin barbel absent or rudimentary; upper jaw shorter than or equal to lower jaw; pectoral fin reaching beyond first dorsal fin	5
3a.	Chin barbel very long, equal to or longer than eye diameter; anus under origin of second dorsal fin	*Gadus macrocephalus*
3b.	Chin barbel short, about equal to pupil diameter; anus anterior to origin of second dorsal fin	4

4a.	Chin barbel about equal in length to pupil; anus under posterior insertion of first dorsal fin or interdorsal space; caudal fin yellowish	*Eleginus gracilis*
4b.	Chin barbel slightly longer than pupil; anus under first dorsal fin; caudal fin dark	*Microgadus proximus*
5a.	Lateral line interrupted for entire length; caudal fin moderately forked	6
5b.	Lateral line continuous until about mid-body, caudal fin emarginate or truncate	*Gadus chalcogrammus*
6a.	Lateral line wavy at mid-body; eye diameter ≥25% of head length; palatine teeth absent	*Boreogadus saida*
6b.	Lateral line not wavy, dipping ventrally at mid-body; eye diameter ≤25% of head length; palatine teeth present	*Arctogadus glacialis*

FAMILY MERLUCCIDAE		
1a.	Head length < 30% of standard length; snout length >30% of head length; anal-fin rays ≥39	*Merluccius productus*
1b.	Head length ≥30% of standard length; snout length <25% of head length; anal-fin rays ≤39	*Merluccius angustimanus*
FAMILY MORIDAE		
1a.	Base of anal fin elongate, without noticeable indentation at mid-length	2
1b.	Base of anal fin elongate, with noticeable indentation at mid-length	4
2a.	Anal-fin origin distinctly posterior to second dorsal-fin origin; first or second ray of first dorsal fin elongate	*Lepidion schmidti*
2b.	Anal-fin and second dorsal-fin origins about equal; no elongate rays in first dorsal fin	3

3a.	Chin barbel present; upper jaw longer than lower jaw; ventral light organ present; rays of pelvic fin not reaching beyond anus	*Physiculus rastrelliger*
3b.	Chin barbel absent; upper jaw shorter than lower jaw; ventral light organ absent; rays of pelvic fin reaching beyond anal-fin origin	*Laemonema longipes*
4a.	Snout depressed, forming V-shaped shelf protruding over lower jaw; chin barbel present	*Antimora microlepis*
4b.	Snout not depressed, lower jaw slightly longer than upper; chin barbel absent	*Halargyreus johnsonii*

Order of Presentation

Arctogadus glacialis

Polar cod

Photo credit: Catherine Mecklenburg, Point Stephens Research

Family Gadidae

Description: Body brownish gray with dark fins; chin barbel rudimentary; lower jaw projecting slightly beyond upper jaw; pectoral fin reaching origin of second dorsal fin or more posterior; origin of first anal fin under second dorsal fin; anus at interspace between first and second dorsal fin; caudal fin forked.

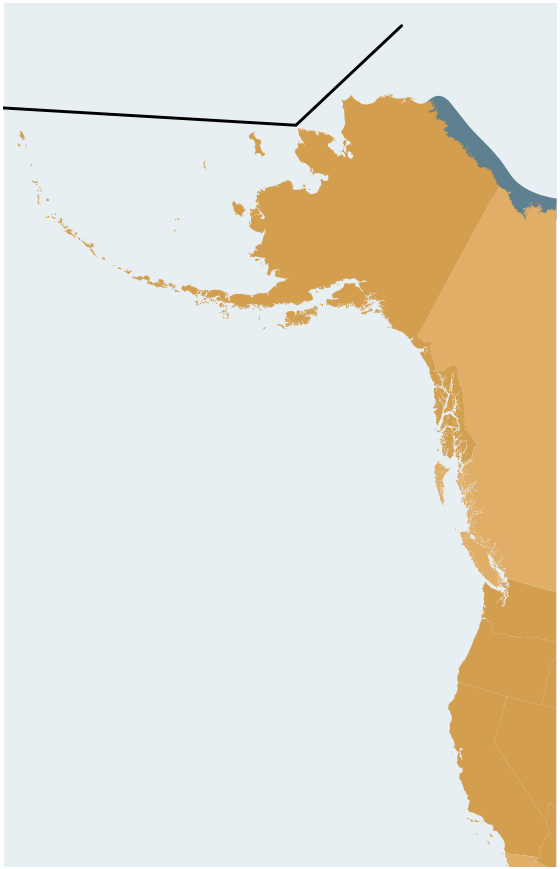
Maximum Size: 32 cm total length.

Depth: 230 m to 930 m.

Distribution: Beaufort Sea; Canada, Russia, North Atlantic.

Ecology: Pelagic to demersal; occurring in large schools at the surface, often associated with ice; not taken commercially; also referred to as Arctic cod (see Mecklenburg et al. 2002).

Similar Species: The polar cod is most similar to the Arctic and saffron cods, Pacific tomcod, and walleye pollock. It can be distinguished by the combination of overlapping scales, presence of palatine teeth, complete lateral line with a distinct dip ventrally at origin of second dorsal fin, pectoral fin reaching to origin of second dorsal fin, and absence of chin barbel. *Arctogadus borisovi* (toothed cod) is considered a synonym of *A. glacialis* (Jordan et al. 2003).



Boreogadus saida

Arctic cod

Photo credit: James W. Orr, Alaska Fisheries Science Center/NOAA

Family Gadidae

Description: Body brownish gray with black speckling; fins gray to dusky, white ventrally; head blunt; lower jaw projecting slightly beyond upper jaw; chin barbel rudimentary; origin of first anal fin under insertion of first dorsal fin or under interspace between first and second fins; caudal fin moderately forked.

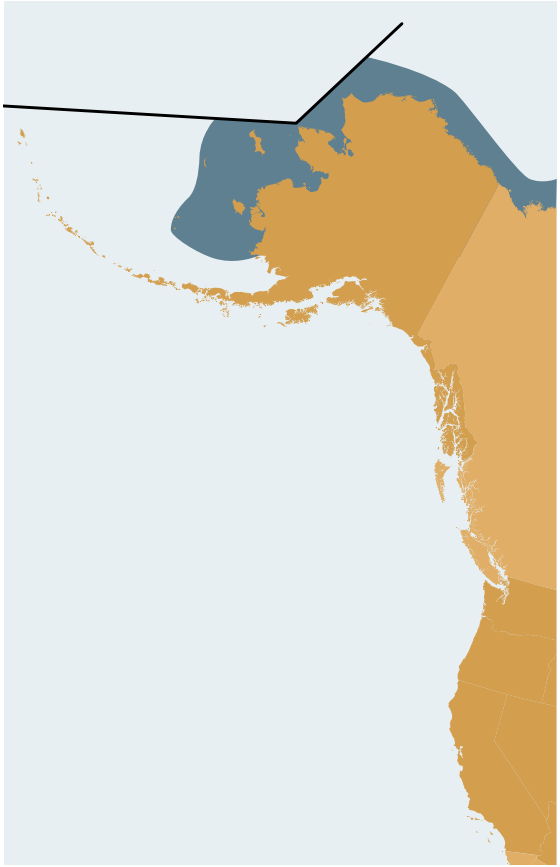
Maximum Size: 40 cm total length (NOAA survey maximum size is 30 cm total length).

Depth: Surface to 731 m.

Distribution: Bering Sea; Russia, Canada, North Atlantic

Ecology: Pelagic to demersal; associated with ice fronts occurring in marine and low salinity waters; one of the most abundant fish species in the Arctic, and an important prey source for seabirds and marine mammals (see Gillispie et al. 1997); not taken commercially; also referred to as polar cod (see Mecklenburg et al. 2002).

Similar Species: The Arctic cod is similar to walleye pollock and polar cod. It can be distinguished by the combination of its reduced chin barbel, overlapping scales, continuous wavy lateral line, and forked caudal fin.



Eleginus gracilis

Saffron cod

Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Description: Body gray-green or yellowish dorsally, white ventrally; fins yellow; chin barbel about one-half orbit length; upper jaw projecting beyond lower jaw; pectoral fin not reaching second dorsal fin; anus located under first dorsal fin or under interspace between first and second dorsal fins; caudal fin truncate.

Maximum Size: 55 cm total length (NOAA survey maximum size is 43 cm total length).

Depth: Surface to 200 m.

Distribution: Alaska; Canada, Russia, Japan, Korea.

Ecology: Pelagic to demersal; associated with ice fronts entering brackish and fresh water (Cohen et al. 1990); important prey source for seabirds and marine mammals (Lowry et al. 1981); historically landed in Russian commercial fisheries, and supported Alaskan subsistence fisheries for many years (Cohen et al. 1990).

Similar Species: The saffron cod is similar to the Pacific tomcod and Pacific cod. It can be distinguished from both by a combination of its small size, short chin barbel, yellow fins, origin of first anal fin about even with origin of second dorsal fin, and truncate caudal fin.

Gadus chalcogrammus

Walleye pollock

Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Description: Body mottled gray, blue or yellow dorsally, white to gray ventrally; fins dusky; chin barbel rudimentary; lower jaw projects beyond upper jaw; origin of first anal fin under origin of second dorsal fin, anus aligned below interspace between first and second dorsal fins; caudal fin emarginate.

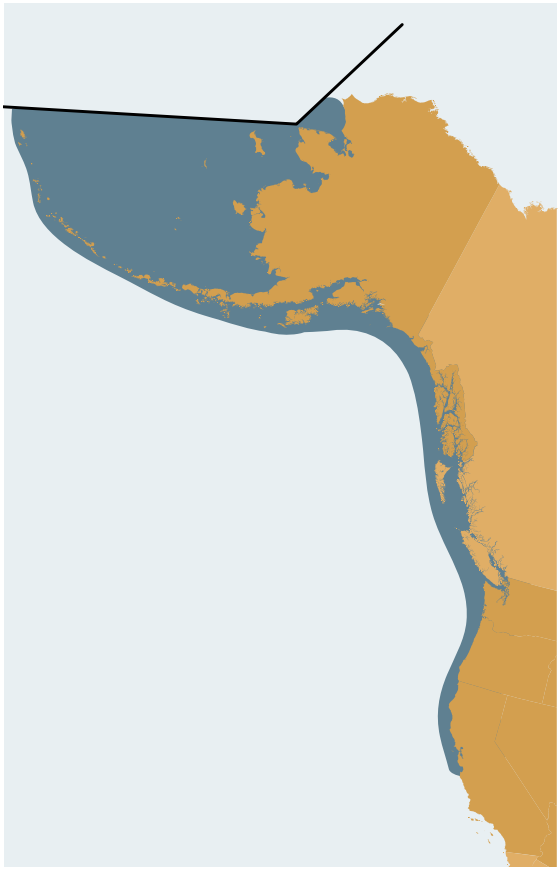
Maximum Size: 91 cm total length.

Depth: Surface to 950 m.

Distribution: California to Alaska; Russia, Japan.

Ecology: Pelagic to demersal; the largest single-species fishery in the U.S.; sold as fish fillets, surimi, and roe; an important source of prey for many marine mammals and large fish species (Frost and Lowry 1981).

Similar Species: The walleye pollock is similar to the Arctic and polar cods and the Pacific and Panama hakes. It can be distinguished from the cods by the caudal fin shape (emarginate in walleye pollock, forked in polar and Arctic cods), and presence of lateral line pores on the head that are absent in polar and Arctic cods. The walleye pollock can be distinguished from the hakes by the presence of three distinct dorsal fins and two distinct anal fins. Recent genetic evidence placed the walleye pollock in the genus *Gadus* (Carr 2008).



Gadus macrocephalus

Pacific cod

Photo credit: Gerald R, Hoff, Alaska Fisheries Science Center/NOAA

Family Gadidae

Description: Body mottled or spotted yellow to greenish dorsally, gray to white ventrally; fins dusky yellow; head large; chin barbel longer than orbit; upper jaw projecting beyond lower jaw; pectoral fin short, not reaching second dorsal fin; anal-fin origin under second dorsal fin; anus under origin of second dorsal fin; caudal fin truncate or emarginate.

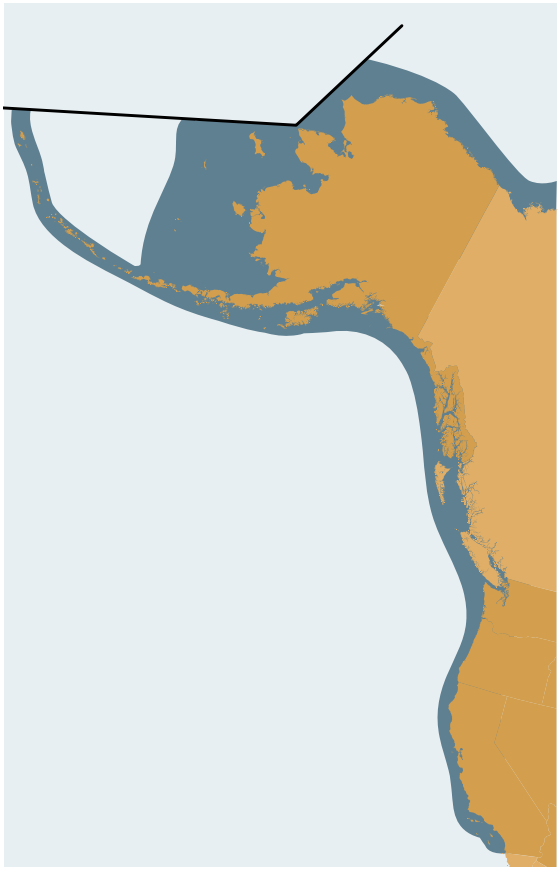
Maximum Size: 120 cm total length.

Depth: Surface to 875 m.

Distribution: California to Alaska; Canada, Russia, Japan, Korea.

Ecology: Pelagic to demersal, broad seasonal migrations across range (Shimada and Kimura 1994); supports one of Alaska's largest fisheries, sold as fish fillets.

Similar Species: The Pacific cod is similar to the Pacific tomcod and saffron cod but can be distinguished by its much larger size, chin barbel longer than orbit diameter, lateral line continuous from the head nearly to caudal peduncle, predorsal distance >33% of standard length, and mottling or spotting on the dorsal surface. The Pacific cod and the ogac (*Gadus ogac*) are considered a single species (Carr 1999).



Lota lota
Burbot

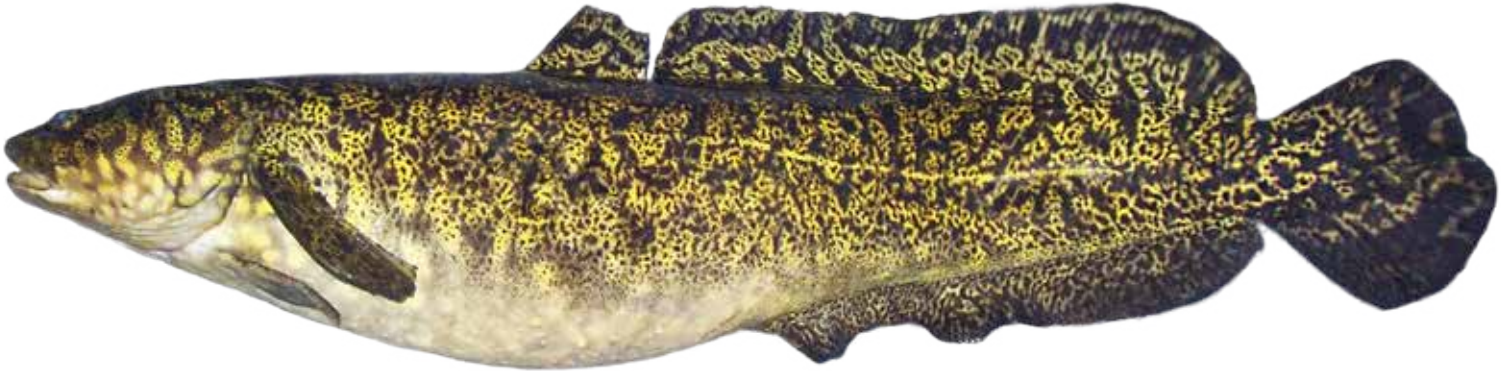


Photo credit: Corey J. Schwanke, Alaska Department of Fish and Game

Description: Body and fins yellow-brown dorsally with darker mottling, lighter ventrally; chin barbel longer than orbit; pectoral fin short, not reaching origin of first dorsal fin; anus under second dorsal fin; caudal fin rounded.

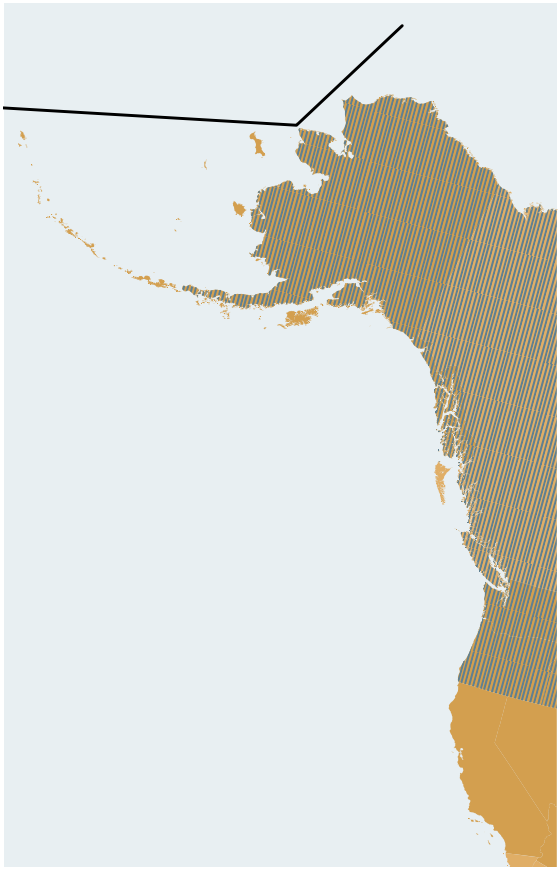
Maximum size: 152 cm total length.

Depth: Surface to 213 m.

Distribution: Freshwater, circum-arctic, south to 40° N, across North America; Canada, Europe, Russia.

Ecology: Benthic; occurs inland in lakes, rivers, and streams; not taken commercially; caught frequently in freshwater sport fishing.

Similar species: The burbot can be distinguished from other gadiforms by its elongate eel-like body, long chin barbel, fleshy flap on nostrils, short pelvic and pectoral fins that fall short of or just reach the anterior portion of the first dorsal fin, and rounded caudal fin.



Microgadus proximus

Pacific tomcod

Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Description: Body green to yellow dorsally, speckled to pale ventrally; fins dusky; chin barbel about one-half orbit; upper jaw projecting beyond lower jaw; origin of first anal fin under first dorsal fin; lateral line continuous to end of third dorsal fin, interrupted to caudal fin; anus under first dorsal fin; caudal fin truncate.

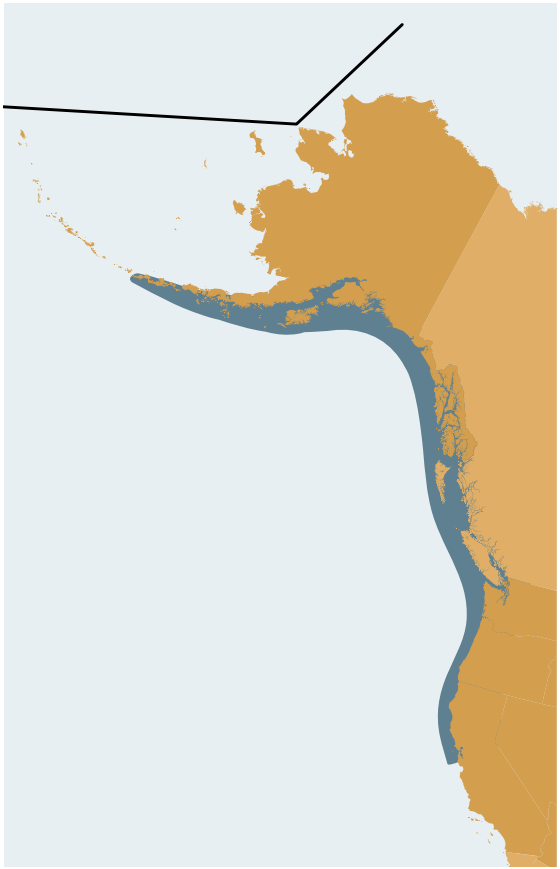
Maximum Size: 37 cm total length.

Depth: 25 m to 260 m.

Distribution: California to Alaska.

Ecology: Demersal; in shallow marine waters and entering brackish waters along coast; not taken commercially.

Similar Species: The Pacific tomcod is similar to the saffron cod and the Pacific cod. It can be distinguished by the combination of its small size, chin barbel about one-half orbit length, lateral line continuous to the insertion of the third dorsal fin, and first anal fin beginning under the first dorsal fin.



Albatrossia pectoralis

Giant grenadier

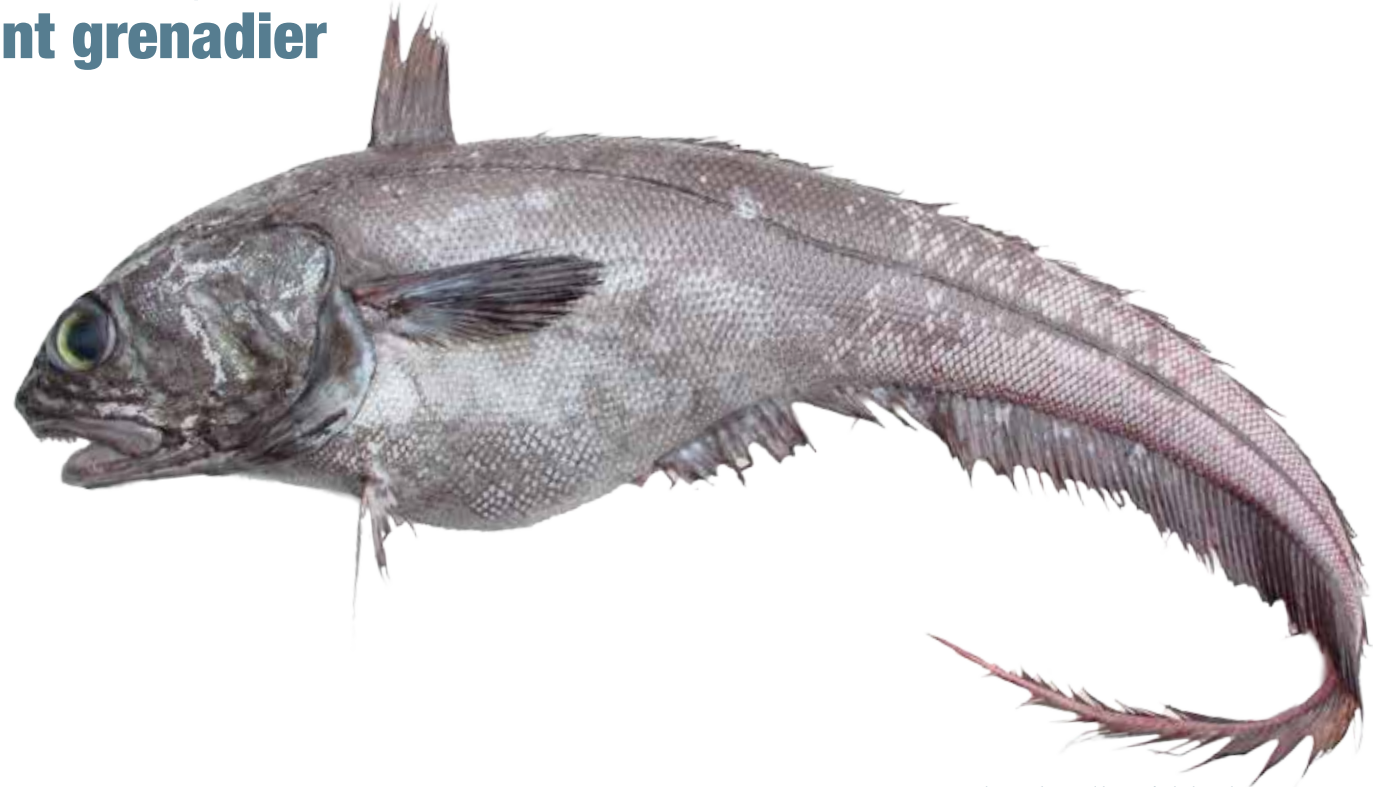


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body dusky gray, with large iridescent, deciduous scales; often bluish white when denuded of scales; fins gray to black; body large and watery; mouth large; maxilla extending to posterior edge of orbit; snout extending slightly beyond mouth, without spinous scutes or scales; chin barbel about one-fourth orbit length; pelvic, pectoral, and dorsal fins short; otolith elongate, comb-shaped in large individuals; seven branchiostegal rays.

Maximum Size: To at least 175 cm total length.

Depth: 140 m to 1,200 m.

Distribution: California to Alaska; Mexico, Russia, Japan.

Ecology: Demersal to pelagic; feeds on squids and fishes (Drazen et al. 2001); not taken commercially but abundant in bycatch of deepwater fisheries in Alaska.

Similar Species: The giant grenadier is distinguished from all other species in the eastern Pacific by its large body size, large mouth with maxilla extending beyond orbit, 6–8 pelvic fin rays, short first pelvic fin ray, unique elongate comb-shaped otolith, and 10–11 scale rows between lateral line and first dorsal fin; anus located at origin of anal fin.

Coelorinchus scaphopsis

Shoulderspot grenadier

Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body gray-brown with scales, blue-gray when denuded of scales; fins dusky; scales large and adherent; snout elongate, projecting distinctly beyond mouth forming conspicuous lateral ridges on sides of head; scales absent on underside of snout; chin barbel less than one-third orbit; second dorsal-fin spine smooth; anus slightly forward of anal-fin origin; conspicuous fossa located between pelvic-fin bases; six branchiostegal rays.

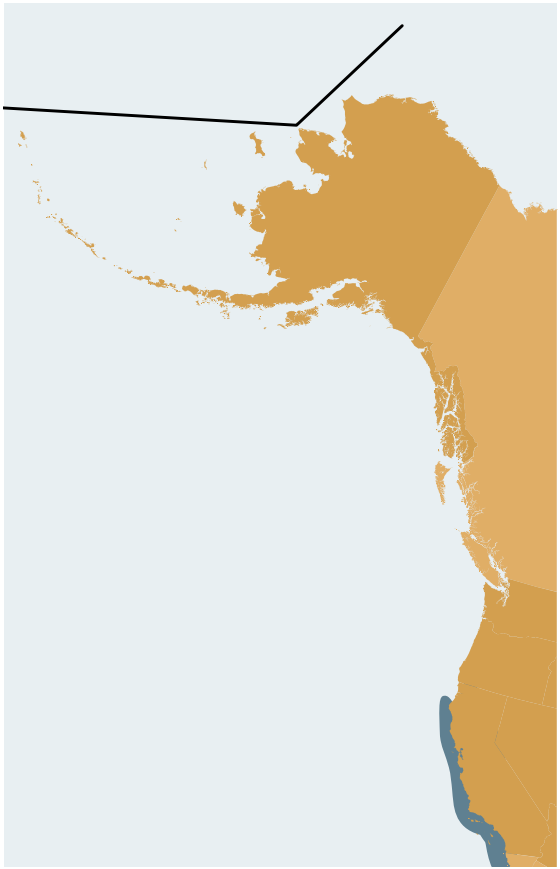
Maximum Size: 34 cm total length.

Depth: 183 m to 296 m.

Distribution: California; Mexico.

Ecology: Demersal to benthopelagic; not taken commercially but locally abundant and frequently encountered in commercial fisheries off California (Cohen et al. 1990).

Similar Species: The shoulderspot grenadier is distinguished from all other species in the region by the combination of a strong suborbital shelf that forms a distinct projecting snout extending beyond the mouth, anus located forward of the anal-fin origin and with a light organ, small body size, and the absence of scales below the snout.



Coryphaenoides acrolepis

Pacific grenadier

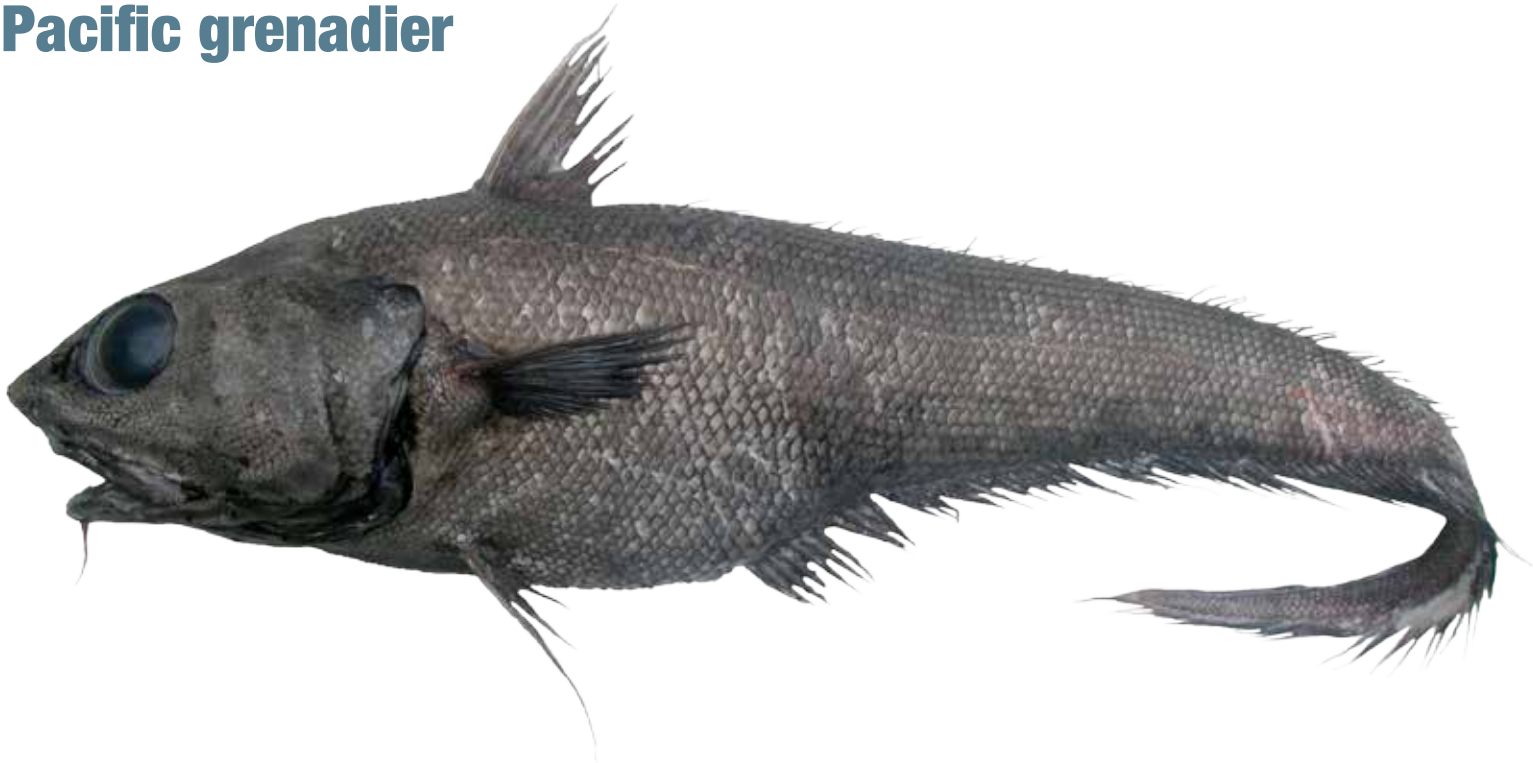


Photo credit; Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body brown-gray to jet black with adherent scales, brown-gray when denuded of scales; fins dusky; chin barbel about one-half orbit; entire snout edged with adherent rows of scales; anus at origin of anal fin; six branchiostegal rays.

Maximum Size: 87 cm total length.

Depth: 600 m to 2,500 m.

Distribution: California to Alaska; Mexico, Russia, Japan.

Ecology: Demersal to pelagic; known to occur thousands of meters off bottom (Cohen et al. 1990); feeds on fish, squid, and crustaceans (Drazen et al. 2001); commercially important in U.S. and Japanese waters, where it is marketed as fresh filets (Cohen et al. 1990).

Similar Species: The Pacific grenadier is similar to the popeye and filamented grenadiers. It can be distinguished from these by a combination of its larger size, darker coloration, adherent scales, absence of a distinct single snout scute, head evenly covered in scales, and long chin barbel (>11% of head length).

Coryphaenoides armatus

Abyssal grenadier

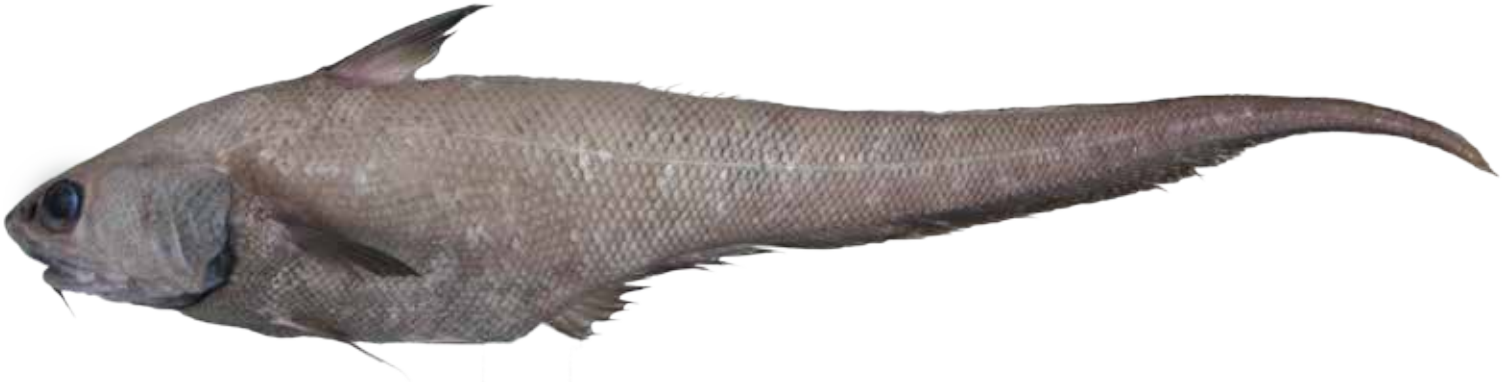


Photo credit: Andrew Stewart, Museum of New Zealand Te Papa

Family Macrouridae

Description: Body dark gray-brown; fins dusky; scales thin and deciduous; lips fleshy and papillose; snout slightly projecting, with sparse scales on underside; chin barbel slightly shorter than orbit; suborbital shelf with 4–5 scale rows; sensory pores on head and jaw large and prominent; anus at anal-fin origin; six branchiostegal rays.

Maximum Size: 102 cm total length.

Depth: 2,000 m to 4,700 m.

Distribution: California to Alaska; Atlantic and Pacific oceans.

Ecology: Demersal to benthopelagic; feeds on benthic crustaceans and carrion (Drazen et al. 2009); not taken commercially (Cohen et al. 1990).

Similar Species: The abyssal grenadier is similar to the rough abyssal grenadier, with which it overlaps in distribution in deep-sea environments. It can be distinguished from this species by having a combination of more deciduous scales, 4–5 rows of suborbital scales, a single distinct row of premaxillary teeth, pores around mouth, and a larger and more prominent head.

Coryphaenoides cinereus

Popeye grenadier

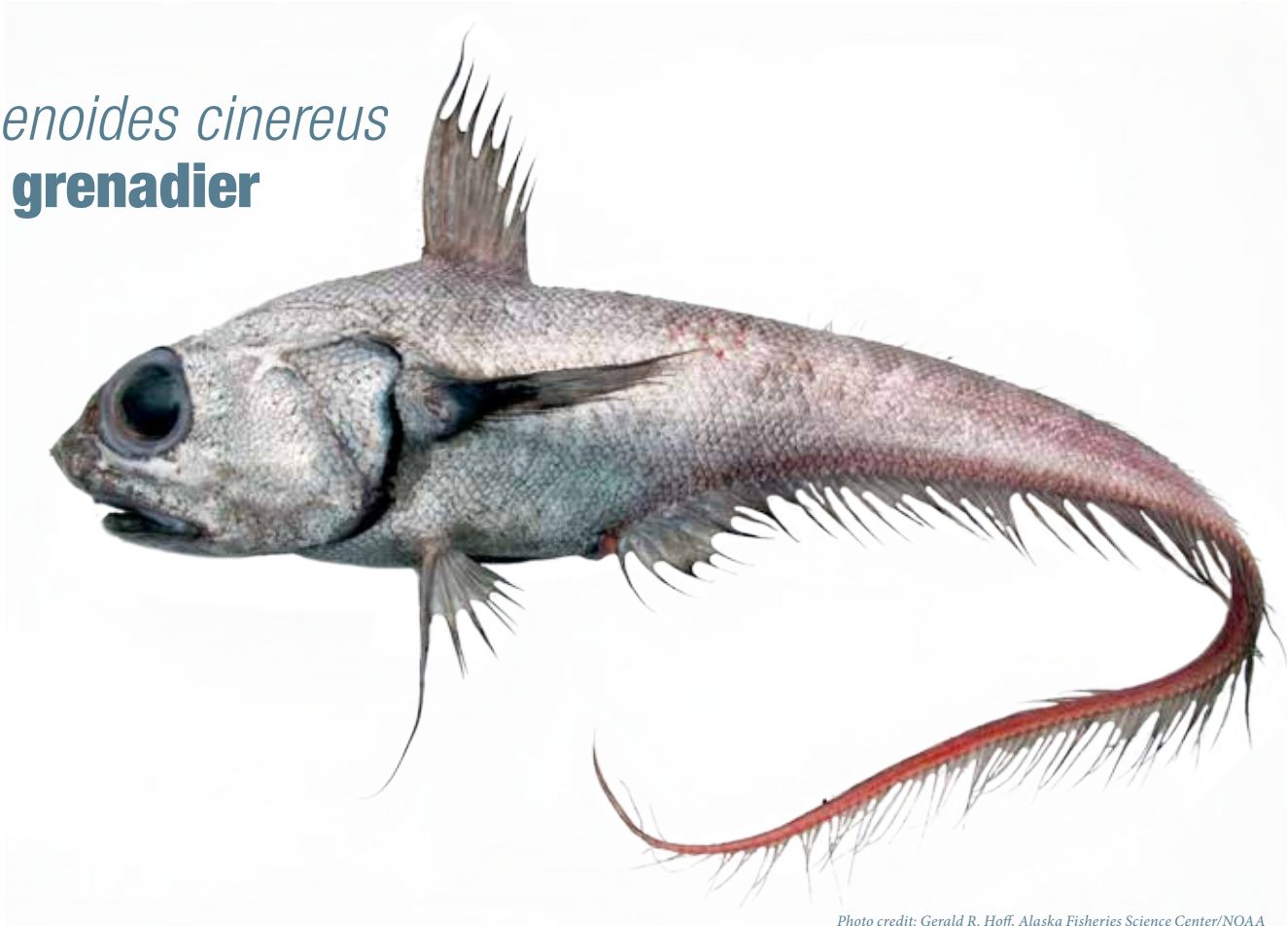


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body light gray-brown with scales, gray to white with bluish tint when denuded of scales, fins dark; chin barbel about one-fourth orbit; anus at anal-fin origin; single spinule on tip of snout; pyloric caeca 5–8, short; six branchiostegal rays.

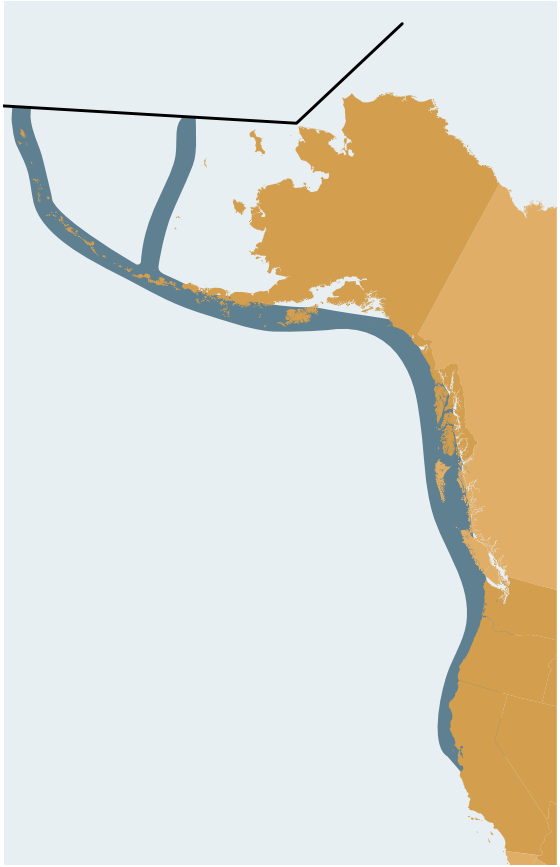
Maximum Size: 56 cm total length.

Depth: 225 m to 2,832 m.

Distribution: California to Alaska; Russia, Japan.

Ecology: Demersal to benthopelagic; important as a food source for Baird's Beaked Whale in Japanese waters (Walker et al. 2002); the most abundant benthic fish species in deep slope waters off Alaska (Hoff and Britt 2011); not taken commercially.

Similar Species: The popeye grenadier is similar to the threadfin grenadier, Pacific grenadier, and the giant grenadier. It can be distinguished from all these by a combination of its small size, light gray-brown coloration, distinct single spinule on snout, smaller mouth with maxilla to about rear portion of eye, and naked suborbital region lacking embedded scales. Length and counts of pyloric caeca are diagnostic for this species, which has 5–8 caeca shorter than orbit; other species have 10 or more caeca that are longer than orbit.



Coryphaenoides filifer

Filamented grenadier

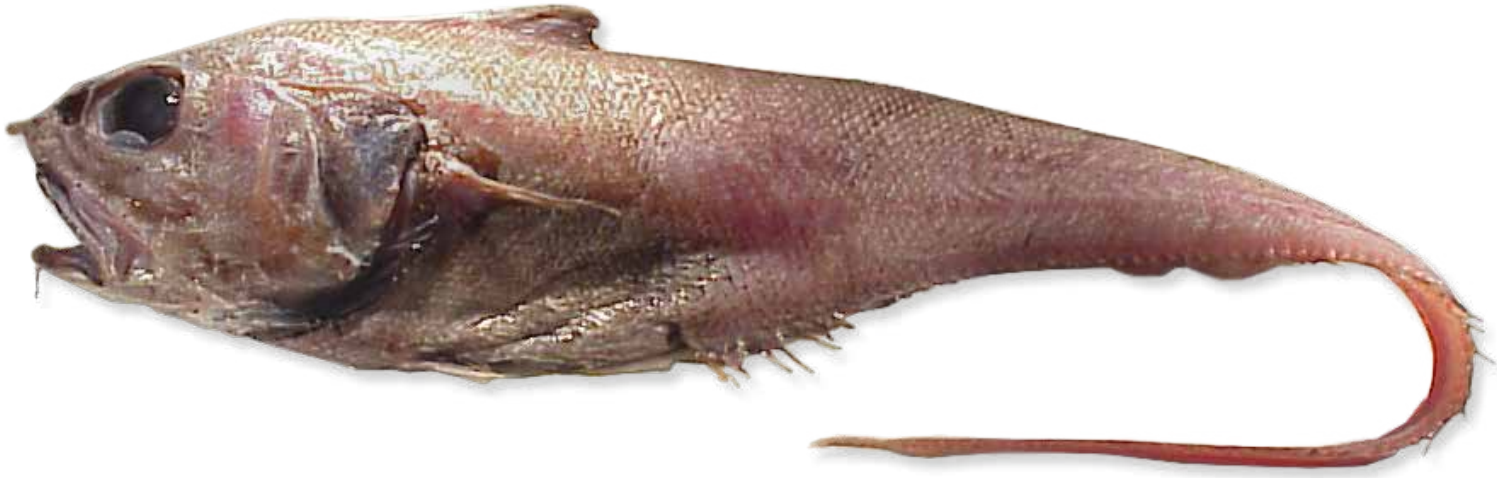


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body gray-brown with scales, white with bluish tint when denuded of scales; chin barbel about one-half orbit; anus at anal-fin origin; distinct rows of embedded scales on suborbital shelf; single scute on end of snout; six branchiostegal rays.

Maximum Size: 66 cm total length.

Depth: 916 m to 2,904 m (previously reported minimum depth 2,067 m).

Distribution: California to Alaska; Russia, Japan.

Ecology: Demersal to bathypelagic; not taken commercially.

Similar Species: The filamented grenadier is similar to the popeye grenadier, Pacific grenadier, and giant grenadier. It can be distinguished from all these by a combination of its small size, light brown coloration, strong scute on snout, and strongly embedded scales in the suborbital region.

Coryphaenoides leptolepis

Ghostly grenadier

Photo credit: Alexei Orlov, Russian Federal Research Institute of Fisheries and Oceanography

Family Macrouridae

Description: Body brown with scales, white to bluish when denuded of scales; fins dark; chin barbel equal to or longer than orbit; blunt snout not projecting much beyond mouth; large sensory pores on head and jaw; first pelvic-fin ray slightly elongate, forming a filament extending to just beyond anus; anus at anal-fin origin; six branchiostegal rays.

Maximum Size: 46 cm total length.

Depth: 640 m to 4,100 m.

Distribution: California; Canada, Mexico, Japan, North Atlantic.

Ecology: Demersal to benthopelagic; not taken commercially.

Similar Species: The ghostly grenadier is distinguished from all other grenadiers in the eastern North Pacific by the combination of the long chin barbel, blunt snout, large head pores, and elongate pectoral and pelvic fins reaching beyond the anus. The bearded grenadier, *Coryphaenoides liocephalus* (not included here), is similar to the ghostly grenadier; with further study the two may be recognized as a single species with a worldwide distribution.

Coryphaenoides longifilis

Longfin grenadier

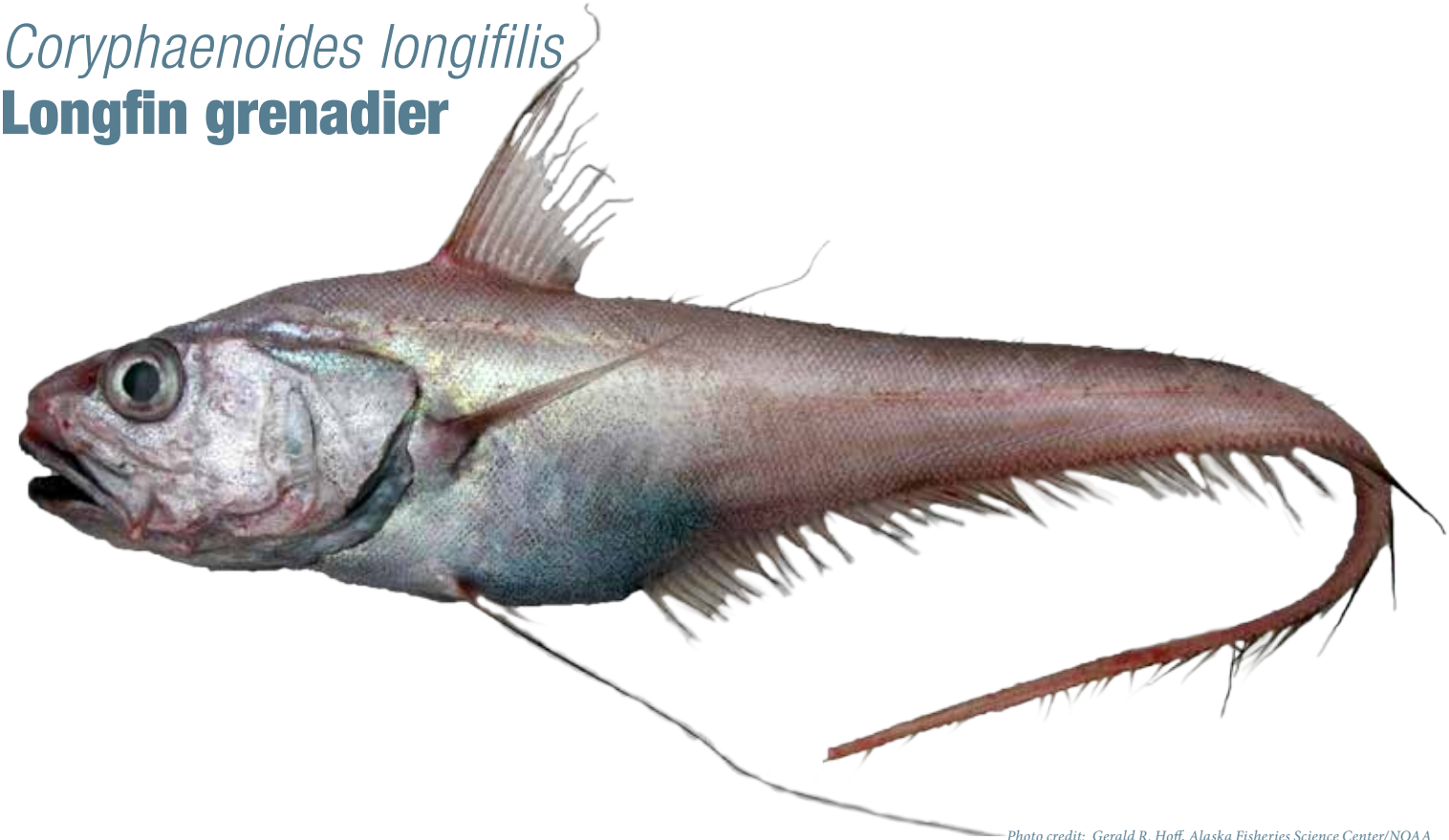


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body brownish with dark fins, white to bluish when denuded of scales; chin barbel rudimentary; both pectoral and pelvic fins reaching beyond anus; first pelvic ray greatly elongate, forming a filament that extends beyond mid-body; blunt snout not projecting much beyond mouth, six branchiostegal rays.

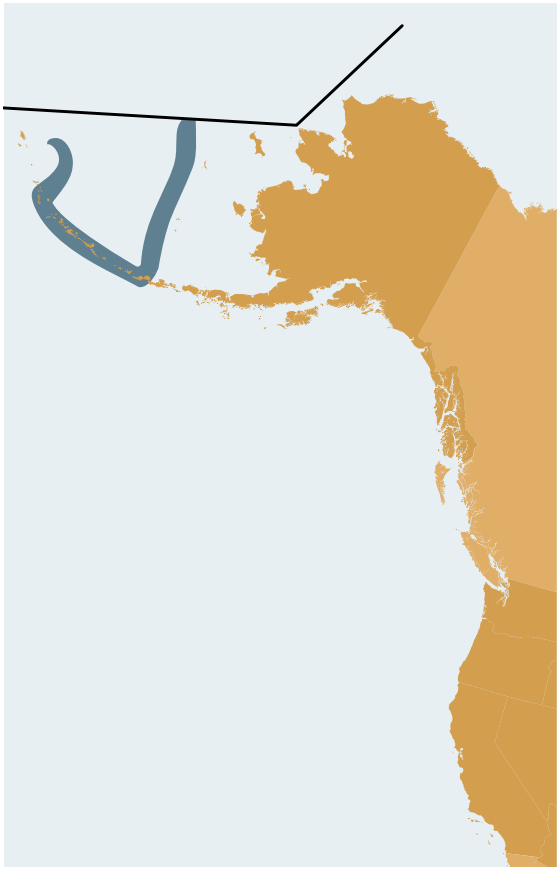
Maximum Size: 86 cm total length.

Depth: 515 m to 2,025 m (previously reported minimum depth 700 m).

Distribution: Alaska; Russia, Japan.

Ecology: Demersal to benthopelagic; important as food source for Baird's beaked whale in Japanese waters (Walker et al. 2002); not taken commercially.

Similar Species: The longfin grenadier is distinguished from all other grenadiers in the area by the combination of elongate pelvic fin rays, rudimentary chin barbel, blunt snout, and pectoral fin reaching well beyond the anus.



Coryphaenoides yaquinae

Rough abyssal grenadier

Photo credit: Andrew Stewart, Museum of New Zealand Te Papa

Family Macrouridae

Description: Body dark brown to gray; fins dusky; scales relatively adherent; lips fleshy and papillose; snout slightly projecting with sparse scales on underside; chin barbel about equal in length to orbit; suborbital shelf with two scale rows; sensory pores on head and jaw moderate; anus at anal-fin origin; six branchiostegal rays.

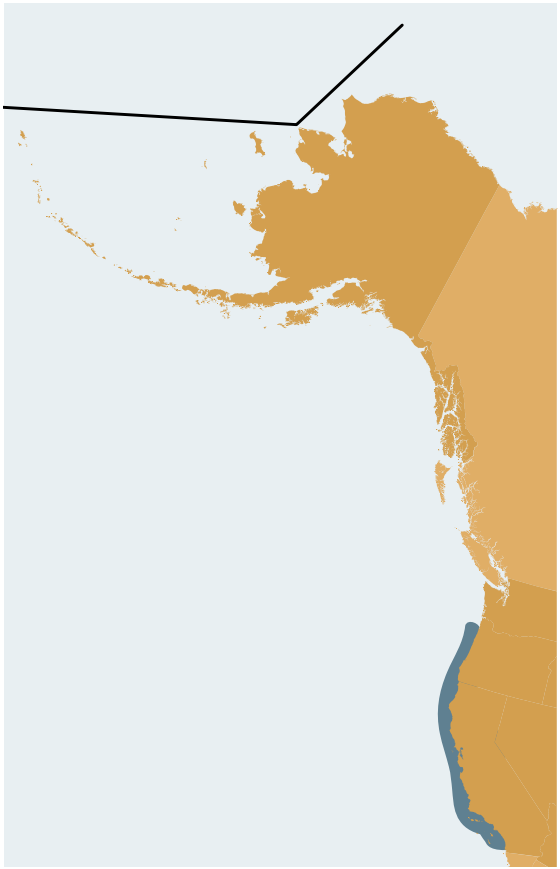
Maximum Size: 77 cm total length.

Depth: 3,400 m to 6,450 m.

Distribution: California to Oregon; Central and North Pacific Ocean.

Ecology: Demersal to benthopelagic; feeds on benthic crustaceans and carrion (Drazen et al. 2009); not taken commercially (Cohen et al. 1990).

Similar Species: The rough abyssal grenadier is similar to the abyssal grenadier, with which it overlaps in distribution in deep-sea environments. It can be distinguished by having a combination of more adherent scales, darker coloration, two rows of suborbital scales, 1–2 rows of premaxillary teeth in indistinct rows or a single band, and less prominent head pores.



Malacocephalus laevis

Softhead grenadier

Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body brownish with scales, blue-white when denuded of scales; fins dusky; snout smooth, rounded, blunt, projecting only slightly beyond mouth, maxilla extends posterior to orbit; orbit greater than twice snout length; chin barbel about one-half orbit; outer branchiostegal rays heavily scaled; second dorsal-fin spine smooth; anus between pelvic fins; conspicuous light organ forward of anus; seven branchiostegal rays.

Maximum Size: 52 cm total length.

Depth: 200 m to 1,000 m.

Distribution: California; Mexico, Pacific and Atlantic oceans.

Ecology: Benthopelagic; not taken commercially but encountered in local fisheries as bycatch.

Similar Species: The softhead grenadier is most similar to the smooth grenadier, with which it overlaps in distribution. The softhead grenadier can be distinguished from all others in the region by a combination of the anus forward of anal-fin origin, large naked fossa between pelvic fins, scales deciduous, maxilla extending to posterior part of orbit, and orbit about two times snout length.

Mesobius berryi

Berry's grenadier

Photo of Preserved Specimen

Photo credit: CSIRO Australian National Fish Collection

Family Macrouridae

Description: Body black with dark fins; chin barbel absent; elongate scales on head; snout blunt, bulbous; anus slightly forward of anal-fin origin; light organ anterior of anus; second dorsal-fin spine with small serrations; seven branchiostegal rays.

Maximum size: 41 cm total length (Iwamoto and Hubbs 1977).

Depth: Surface to 1,200 m (Iwamoto and Hubbs 1977).

Distribution: California; Hawaii, Central Pacific.

Ecology: Bathypelagic to pelagic; not taken commercially.

Similar species: Berry's grenadier is most similar to other small grenadiers from the area, such as species of *Nezumia,* and particularly the softhead grenadier (*Malacocephalus laevis*). Berry's grenadier is distinguished from all other species by the combination of chin barbel absent, anus near pelvic-fin insertion, and snout equal to or longer than the orbit (in *Nezumia* and *Malacocephalus* the snout is only about one-half the length of the orbit).

Nezumia kensmithi

Blunt-nosed grenadier

Photo of Preserved Specimen

Photo credit: Daniel D. Conley and H.J. Walker Jr. SIO Marine Vertebrate Collection

Family Macrouridae

Description: Body brown anteriorly and blue-black mid-body; fins dark; chin barbel less than one-fourth orbit; snout blunt, scales absent ventrally; second dorsal-fin spine with small serrations; anus between pelvic fins; light organ posterior to anus; seven branchiostegal rays.

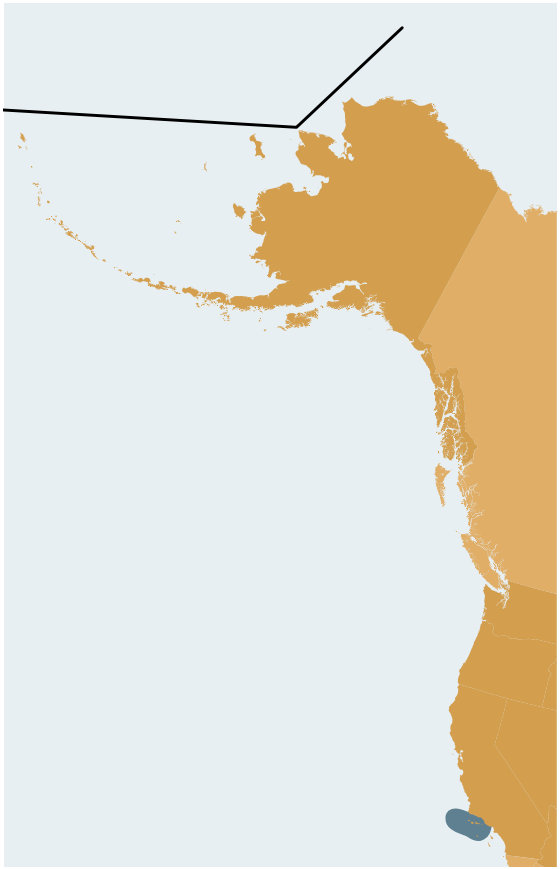
Maximum size: 40 cm total length (Wilson 2001).

Depth: 555 m (Wilson 2001).

Distribution: California; Pacific Ocean.

Ecology: Demersal to bathypelagic over seamounts; not taken commercially.

Similar species: The blunt-nosed grenadier is similar to the California grenadier. The California grenadier has 9–10 rays in the pelvic fin; the blunt-nosed grenadier has 11–12.



Nezumia liolepis

Smooth grenadier

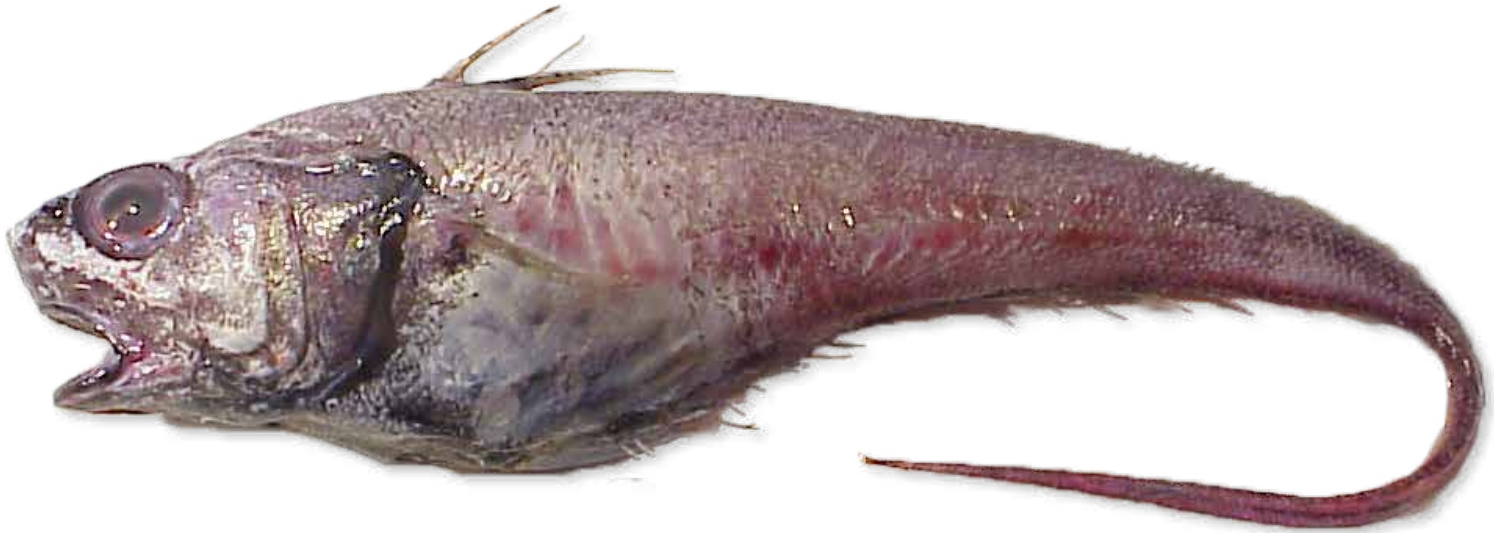


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body gray-brown with scales, violet-gray when denuded of scales; fins dusky; scales deciduous; chin barbel about one-half orbit; snout projecting slightly beyond mouth; scales on underside of head absent; second dorsal-fin spine with very small serrations or smooth; anus slightly forward of anal-fin insertion; seven branchiostegal rays.

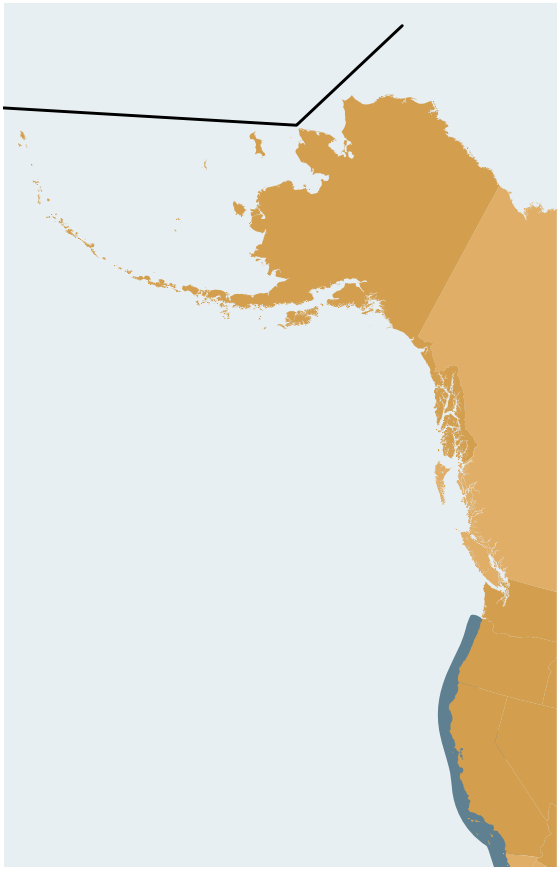
Maximum Size: 30 cm total length.

Depth: 768 m to 1,655 m.

Distribution: California to Washington; Mexico.

Ecology: Demersal to benthopelagic; not taken commercially.

Similar Species: The smooth grenadier is most similar to the California grenadier and softhead grenadier, both of which it overlaps in distribution. The smooth grenadier can be distinguished by its more deciduous scales, second dorsal-fin spine nearly smooth, light organ inconspicuous or absent, anus between pelvic- and anal-fin insertions, overall light coloration, and snout more than one-half orbit length.



Nezumia stelgidolepis

California grenadier

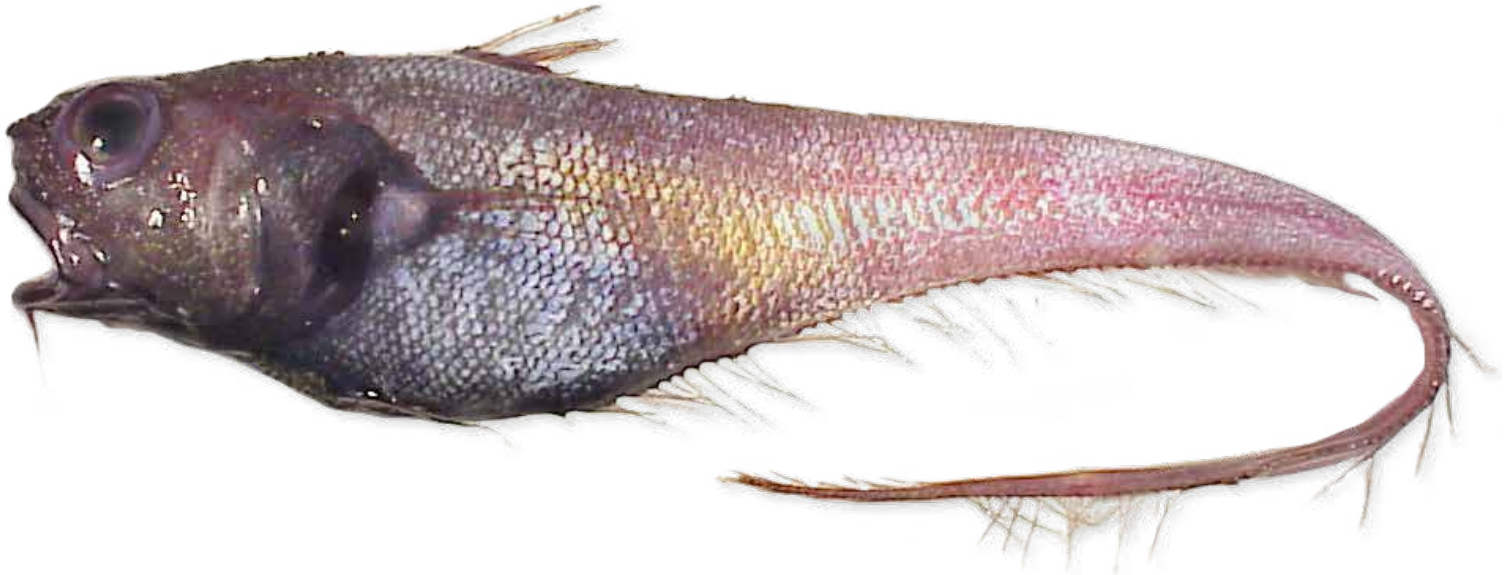


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body color bluish black with scales, blue-gray when denuded of scales; fins dusky; scales adherent; chin barbel about three- fourths orbit; snout projecting only slightly beyond mouth; underside of head with scales few or absent; second dorsal-fin spine with prominent serrations; anus between pelvic-fin insertions; conspicuous light organ forward of anus; seven branchiostegal rays.

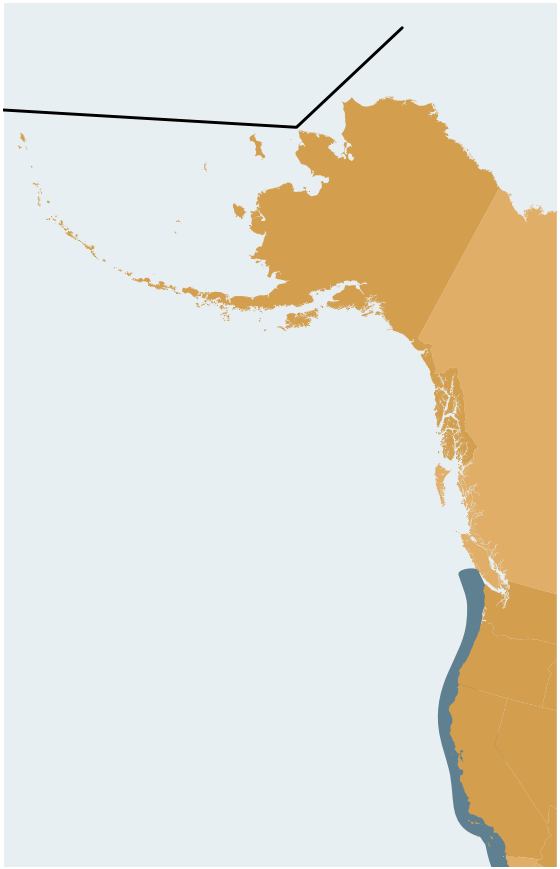
Maximum Size: 45 cm total length.

Depth: 277 m to 909 m.

Distribution: California to Washington; Canada, Mexico.

Ecology: Demersal to benthopelagic; not taken commercially.

Similar Species: The California grenadier is most similar to the smooth grenadier, with which it overlaps in distribution. The California grenadier can be distinguished by its more adherent rougher scales, dark blue coloration, highly serrated spinous dorsal-fin ray, prominent light organ between pelvic-fin bases, and robust body form.



Melanonus zugmayeri

Arrowtail

Photo credit: Alberto Serrano, Instituto Español de Oceanografía

Family Macrouridae

Description: Body dark brown to black; fins dark; scales large; mouth large with many rows of external teeth; snout blunt; chin barbel absent; dorsal fin single; dorsal, pelvic, and pectoral fins elongate, not reaching the anus; caudal fin elongate and pointed; head pores large, conspicuous.

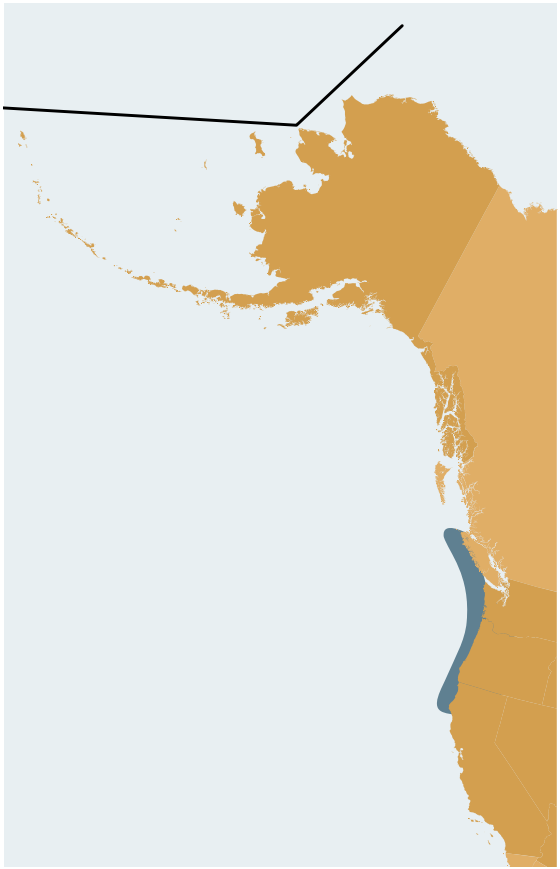
Maximum Size: 30 cm total length (Love et al. 2005).

Depth: Surface to 1,291 m (Love et al. 2005).

Distribution: California; Canada and Pacific, Indian, Atlantic oceans.

Ecology: Meso- to bathypelagic; not taken commercially.

Similar Species: The Arrowtail is most similar to codlings and hakes; however, the combination of coloration, small size, absence of a chin barbel, unique elongate caudal fin, and large head pores distinguishes this species from all others in the area.



Merluccius angustimanus

Panama hake

Photo credit: Ross Robertson, Smithsonian Tropical Research Institute, Panama

Family Macrouridae

Description: Body silvery gray dorsally, silvery white ventrally; fins dusky; chin barbel absent; head relatively long, 30–33% of standard length; pectoral fin elongate, reaching anus; second dorsal fin and single anal fin elongate, with prominent notch at about mid-length; caudal fin truncate.

Maximum size: 40 cm total length.

Depth: 80 m to 500 m.

Distribution: California; Mexico, Central America, Colombia.

Ecology: Demersal to pelagic; taken in small local fisheries.

Similar Species: The Panama hake is most similar to its sister species, the Pacific hake. It can be distinguished by its slightly larger head (>30% standard length). The walleye pollock is also similar, but both the Panama and Pacific hakes can be easily distinguished by having two dorsal fins and one anal fin, elongate second dorsal fin and anal fin with distinct notches, and chin barbel absent.

Merluccius productus

Pacific hake

Photo credit: James W. Orr, Alaska Fisheries Science Center/NOAA

Family Macrouridae

Description: Body silvery gray dorsally, silvery white ventrally; chin barbel absent; head relatively short, <30% of standard length; pectoral fin elongate, reaching anus; second dorsal fin and single anal fin elongate, with prominent notch about mid-length; caudal fin truncate.

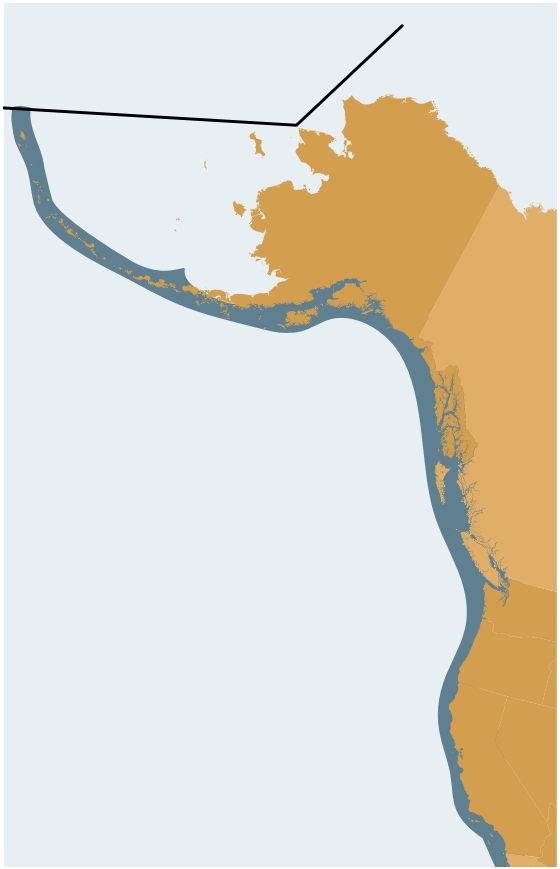
Maximum Size: 91 cm total length.

Depth: Surface to 1,000 m.

Distribution: California to Alaska; Mexico.

Ecology: Demersal to pelagic; important as prey for many larger fishes and marine mammals (Fiscus 1979); commercially important off Oregon, Washington, and British Columbia; used to produce surimi.

Similar Species: The Pacific hake is most similar to its sister species, the Panama hake. It can be distinguished by its slightly smaller head, <30% of standard length. The Pacific hake is also similar to the walleye pollock but can be easily distinguished from it by having two dorsal and one anal fins, elongate second dorsal fin and anal fins with distinct notches, and chin barbel absent.



Antimora microlepis

Pacific flatnose

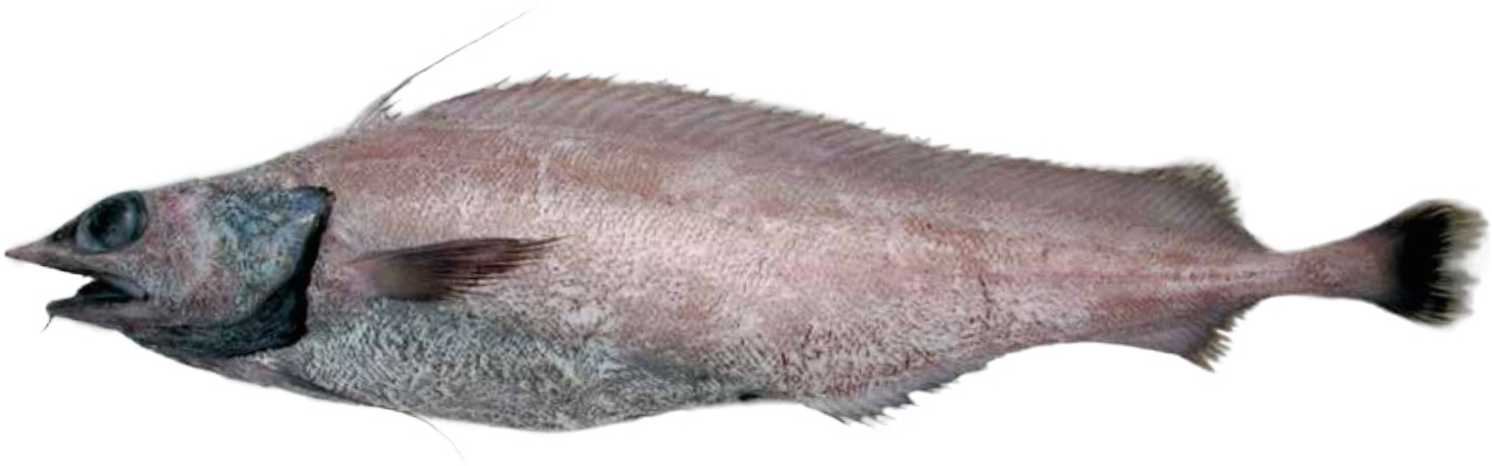


Photo ccredit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Moridae

Description: Body jet black, blue-gray when denuded of scales; fins dusky to dark; first dorsal-fin ray and first pelvic-fin ray elongate; chin barbel about one-fourth orbit; snout protrudes as a dorsoventrally flattened V-shaped rostrum extending greatly beyond the lower jaw; caudal fin truncate.

Maximum Size: 65 cm total length.

Depth: 175 m to 3,048 m.

Distribution: California to Alaska; Mexico, Japan.

Ecology: Demersal to benthopelagic; not taken commercially.

Similar Species: The Pacific flatnose is most similar to other morids. It is unique among species in the area in having a combination of a flattened rostrum that extends as a flat plate considerably past the lower jaw, a prominent chin barbel, and a single short anal fin with a notch about mid-length.

Halargyreus johnsonii

Slender codling

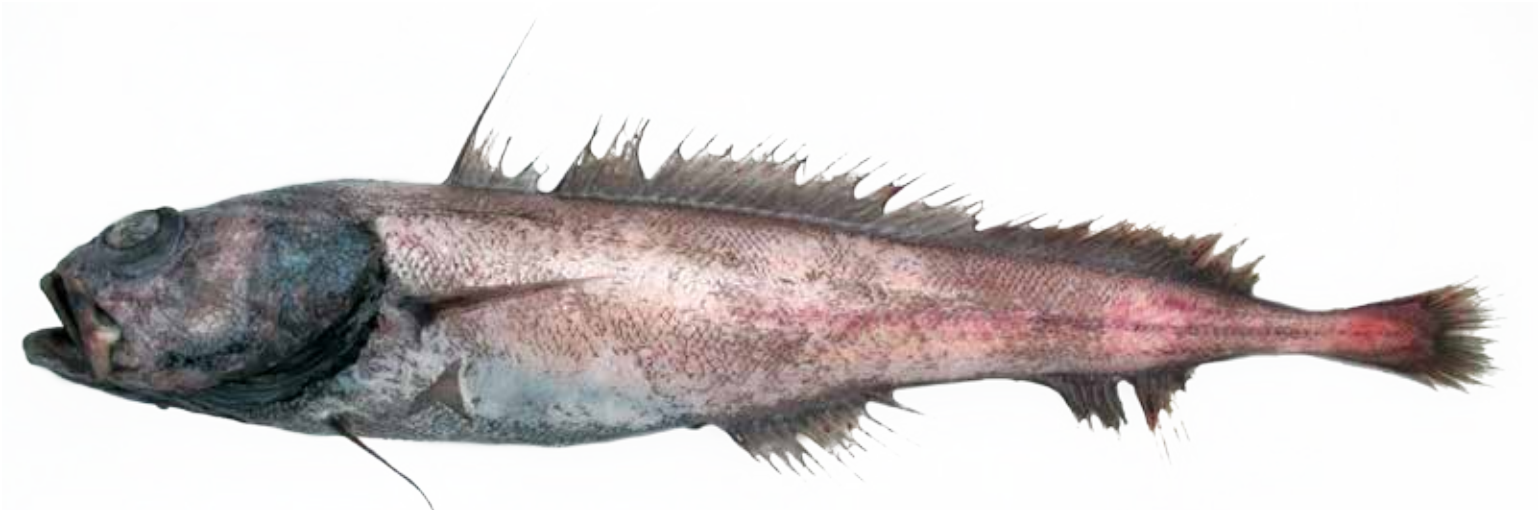


Photo credit: Gerald R. Hoff, Alaska Fisheries Science Center/NOAA

Family Moridae

Description: Body silvery to dusky with scales, whitish blue when denuded of scales; fins dusky; head robust with lower jaw projecting; chin barbel rudimentary; pelvic fin short with slightly elongate ray; dorsal fin without elongate ray; single anal fin with prominent notch about mid-length; caudal fin forked.

Maximum Size: Over 56 cm total length.

Depth: 508 m to 1,500 m.

Distribution: California to Alaska; Pacific and Atlantic oceans.

Ecology: Benthopelagic to pelagic; not taken commercially.

Similar Species: The slender codling is most similar to other morids of the eastern North Pacific. It can be distinguished from all other morids by its combination of chin barbel absent; robust head with projecting lower jaw; anal fin single, notched, and elongate; second dorsal fin without notch; pelvic and pectoral fins not reaching anal fin; and caudal fin moderately forked.

Laemonema longipes
Longfin codling

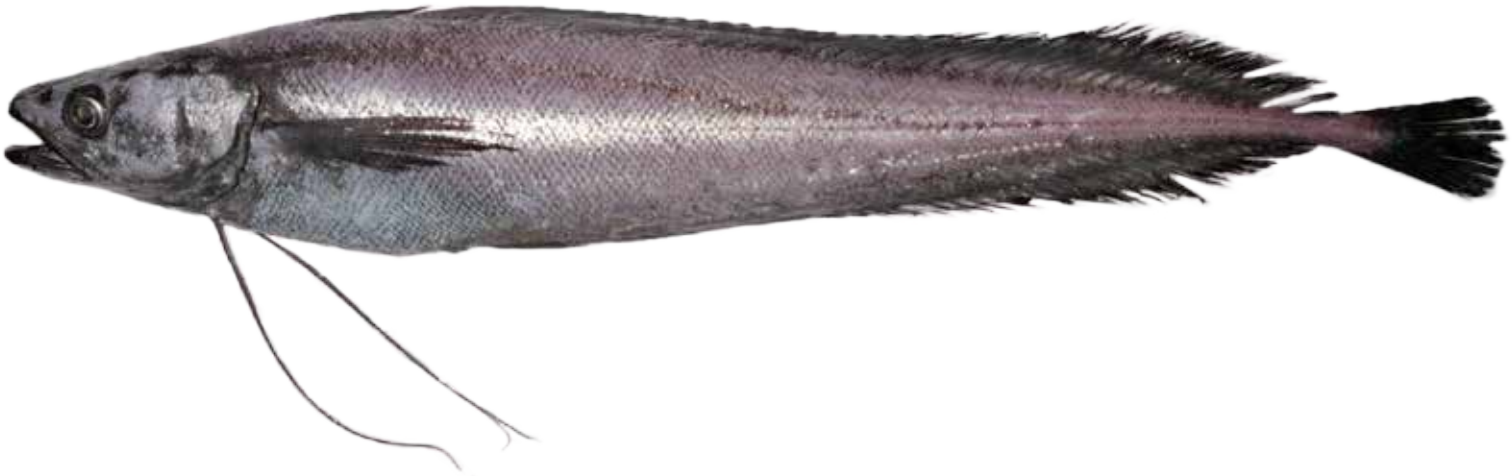


Photo credit: Alexei Orlov,
Russian Federal Research Institute of Fisheries and Oceanography

Family Moridae

Description: Body dusky brown dorsally, whitish when denuded of scales; fins dusky; head small with lower jaw projecting beyond upper jaw; chin barbel absent; second dorsal fin and single anal fin without notches; anal-fin origin about even with second dorsal-fin origin; pelvic fin long and filamentous, reaching beyond anus; caudal fin rounded.

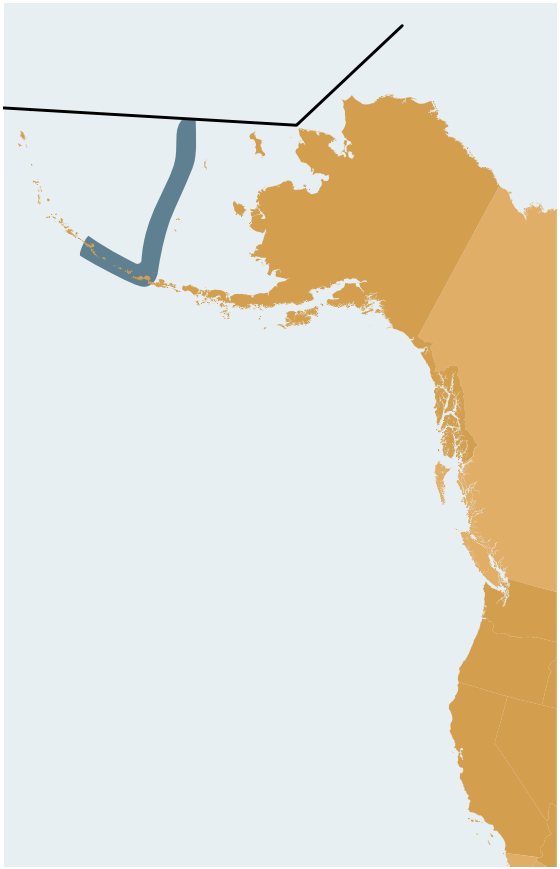
Maximum Size: 60 cm total length.

Depth: 200 m to 2,025 m.

Distribution: Alaska; Japan, Russia.

Ecology: Benthopelagic; important as food source for Baird's beaked whale in Japanese waters (Walker et al. 2002); not taken commercially.

Similar Species: The longfin codling is most similar to other morids of the eastern North Pacific. It can be distinguished from all others by the combination of second dorsal fin and anal fins about equal in length and unnotched, chin barbel absent, and pelvic fins as elongate filaments.



Lepidion schmidti

Northern gray hakeling

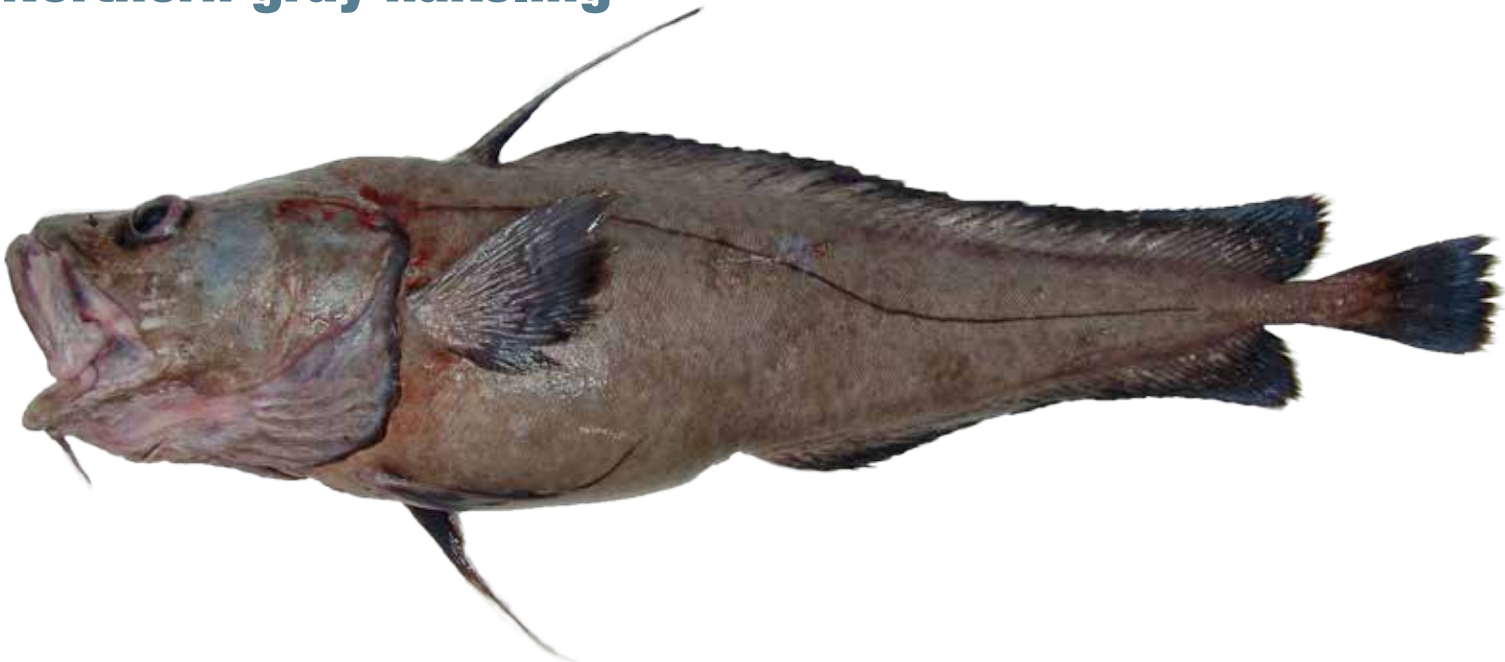


Photo credit: Alexei Orlov,
Russian Federal Research Institute of Fisheries and Oceanography

Description: Body brown to black; fins dusky; snout projecting slightly beyond mouth; chin barbel longer than orbit; second dorsal-fin ray greatly elongate; pectoral fin elongate, nearly reaching anus; second dorsal fin and single anal fin long, unnotched; caudal fin truncate.

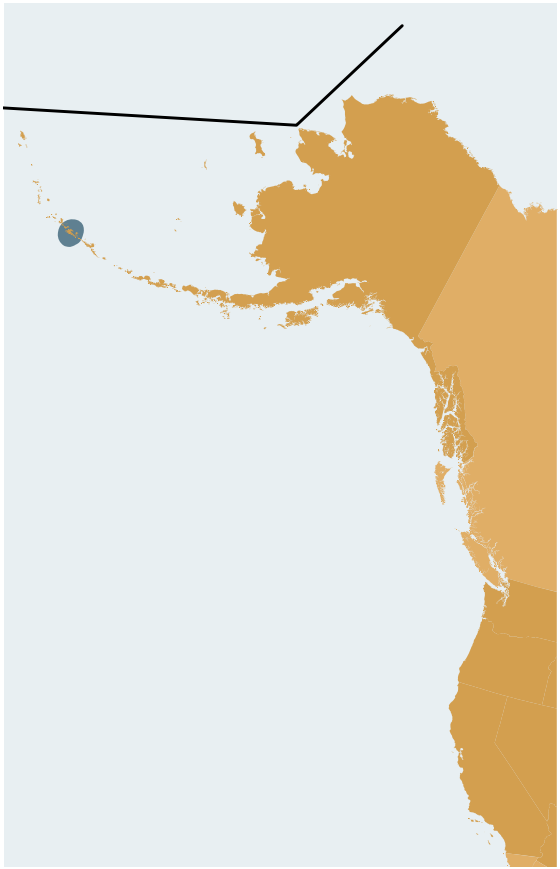
Maximum Size: 101 cm total length.

Depth: 315 m to 1,520 m.

Distribution: Alaska (Alcorn and Stone 2012; from a single record near Adak in the Aleutian Islands); Pacific and Atlantic oceans.

Ecology: Benthopelagic; not taken commercially.

Similar Species: The northern gray hakeling is most similar to other morids and merluccids. The combination of an elongate chin barbel, greatly elongate second dorsal-fin ray, unnotched dorsal and anal fins, and pectoral fin nearly reaching the anus distinguishes this species from all others known in the area. *Lepidion inosimae* is known from the Emperor Seamounts and can be distinguished from *L. schmidti* by a chin barbel shorter than orbit, rounded rather than V-shaped vomerine tooth patch, and a higher number of anal-fin rays (49–55 vs. 39–42).



Physiculus rastrelliger

Hundred fathom mora

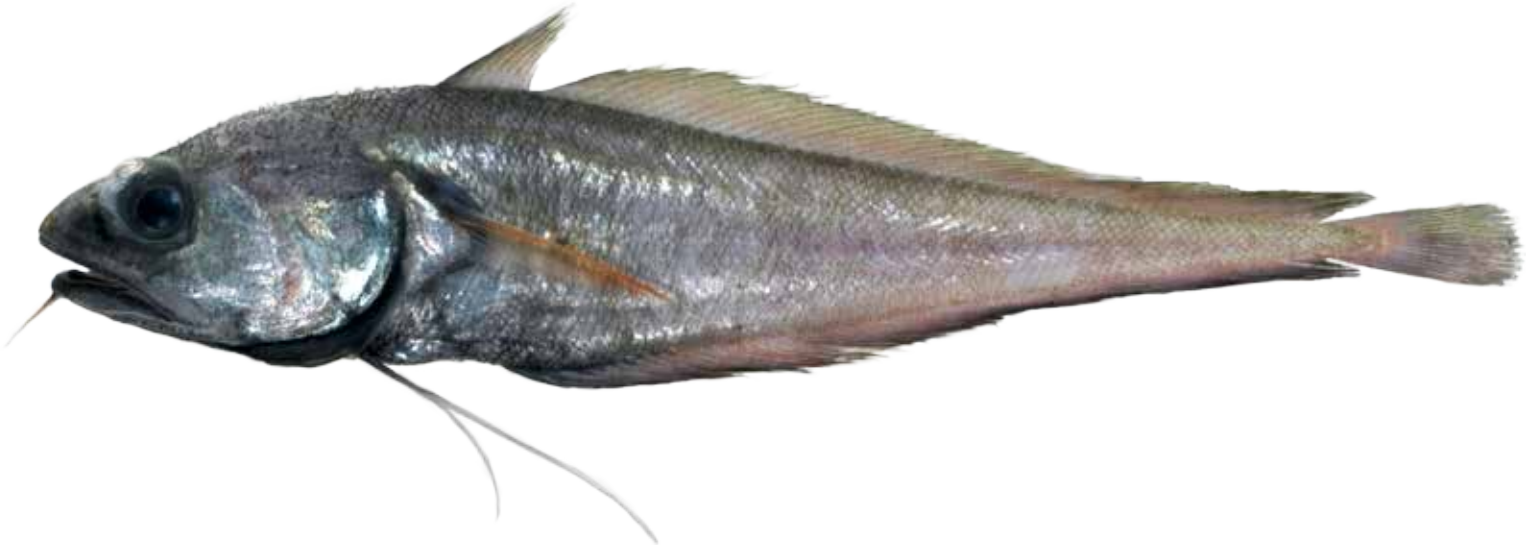


Photo credit: Ross Robertson, Smithsonian Tropical Research Institute, Panama

Family Moridae

Description: Body dusky to gray; fins pale; chin barbel about equal to orbit; no elongate rays in fins; second dorsal fin and anal fin about equal in length and not notched; pectoral fin reaching beyond anus; ventral light organ present; caudal fin rounded.

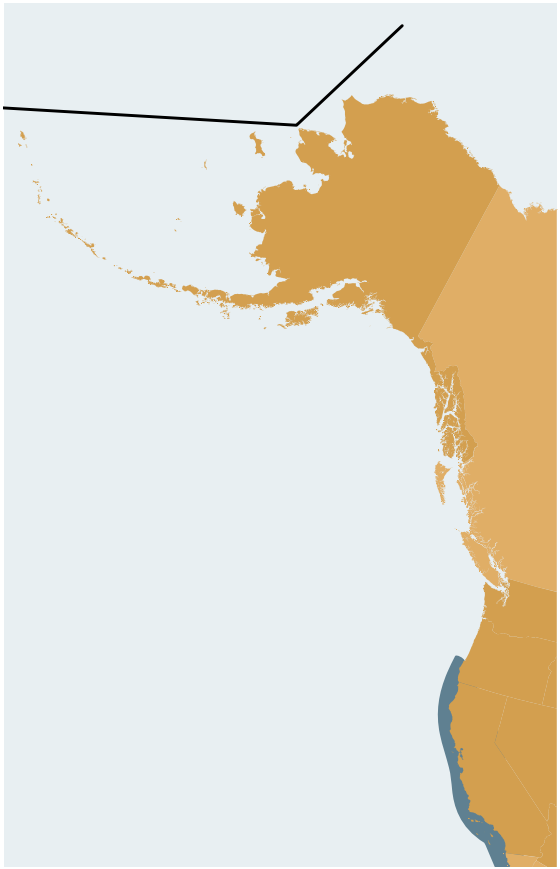
Maximum Size: 20 cm total length.

Depth: 128 m to 518 m (Love et al. 2005).

Distribution: California; Mexico, Central and South America.

Ecology: Benthopelagic; not taken commercially.

Similar Species: The hundred fathom mora is most similar to other morids and merluccids. The combination of a ventral light organ, prominent chin barbel, small body size, second dorsal fin and anal fin about equal in length and not notched, rays on fins not elongate, and rounded caudal fin distinguishes this species from all others.



Glossary

Adherent—sticking or holding fast, as in scales that remain on the body of a fish after capture; opposite of deciduous.

Anal fin—the median ventral unpaired fin located between the anus and caudal fin.

Anus—the excretory opening located on belly or abdomen.

Bathypelagic—living above the bottom at ocean depths from 1,000 m to 4,000 m.

Benthic—living in close association with the bottom.

Branchiostegal rays—bony structures supporting the branchiostegal membrane on the underside of the head.

Caudal fin—tail fin, located at the posterior end of a fish, used mainly for propulsion.

Chin barbel—the elongate fleshy tab located at the junction of the right and left lower jaw, used as a sensory organ.

Deciduous—readily lost or loosely attached, as in scales that are easily lost from a fish after capture; opposite of adherent.

Demersal—referring to a lifestyle of living just above the ocean bottom.

Denuded—lacking natural cover, referring to the loss of scales that many fishes sustain during capture.

Dorsal—describing the direction toward the back or top side of the fish.

Dorsal fin—the median unpaired rayed fin (or fins) located on the dorsal surface.

Embedded scales—scales that are adherent and strongly attached to the skin.

Fin origin—the point at which the fin begins; where the most anterior ray or spine of a fin meets the body.

Fossa—a depression or pit in the head or body.

Head length—the distance from the most anterior point of the snout to the posteriormost edge of the operculum.

Interdorsal—space between the posterior end of one dorsal fin and the origin of the next dorsal fin.

Lateral line—series of sensory organs running along the sides of a fish, usually as a series of pores or modified scales.

Light organ—a specialized organ used to produce light.

Maxilla—main bone of the upper jaw that extends posteriorly below the snout or eye.

Operculum—the covering over the gills and gill cavity located on either side of head, referring to the full series of opercular bones.

Orbit—the opening for the eye that is bordered by the bony structure of the head.

Otolith—a bony structure located in a cavity under the brain, used for balance in fishes.

Papillose—covered with small fleshy tabs or bumps.

Pectoral fin—lateral paired fins located on both sides of a fish, usually just posterior to head.

Pelagic—living well above the ocean bottom and not generally associated with the bottom.

Pelvic fin—ventral paired fins located below or anterior to the pectoral fins.

Planktonic—living in the upper water column, as in the early life stages of some fishes.

Premaxilla—an upper jaw bone anterior to the maxilla.

Premaxillary teeth—teeth on the premaxilla.

Preopercle—a bone of the opercular series, anterior to the opercle.

Pyloric caeca—elongate fleshy tubular structures attached to the posterior end of the stomach.

Scute—an adherent scale with a ridge, point, or keel.

Snout—the anterior part of the head, from the anterior rim of the orbit forward.

Spinule—a small spiny projection ending in a sharp point.

Suborbital shelf—area of the head between the eye and the upper jaw, may project slightly outwards.

Swimbladder—an air-filled organ located in the gut cavity, used for buoyancy.

Ventral—describing the direction toward the bottom of the fish.

About the Authors

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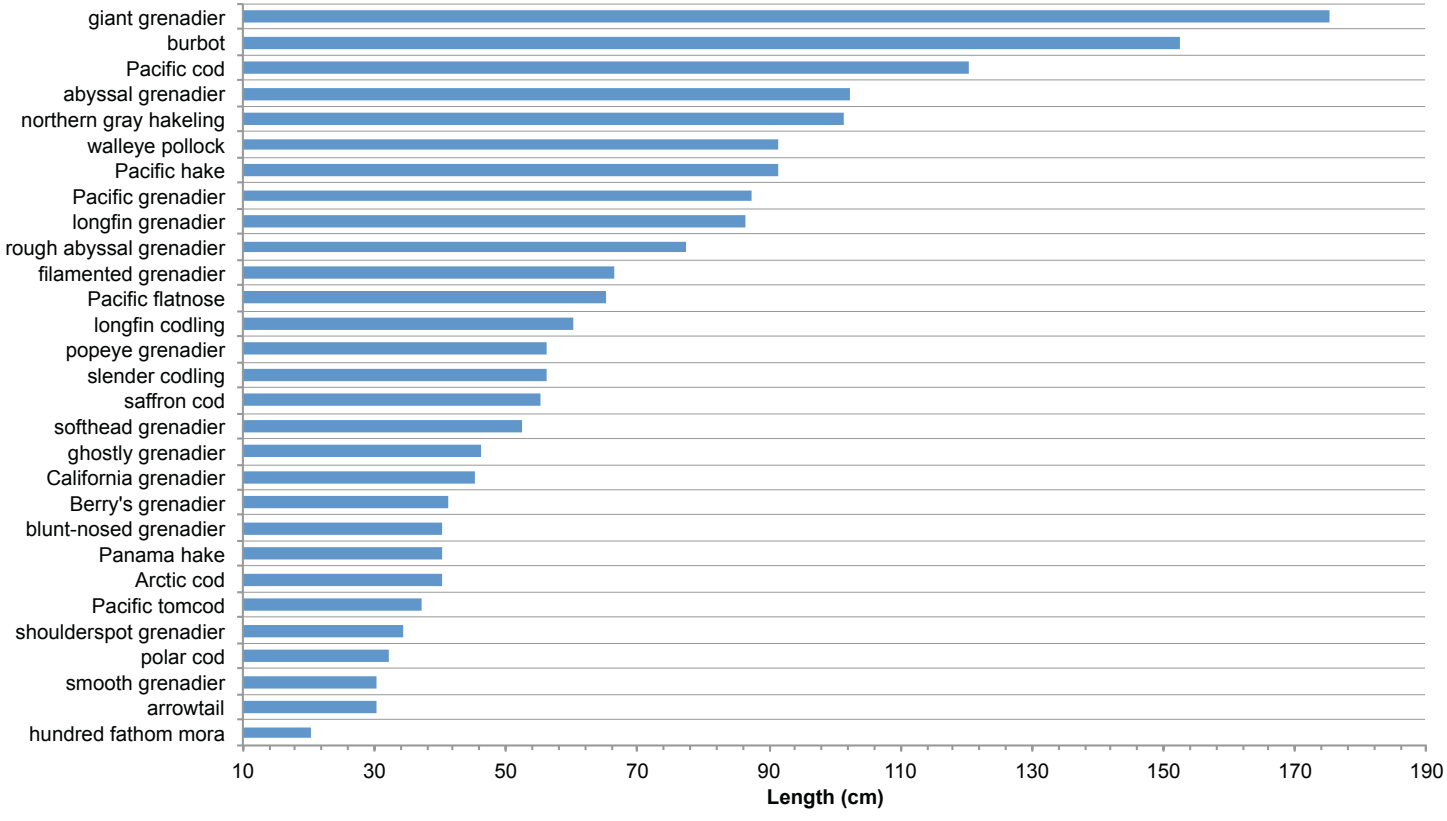
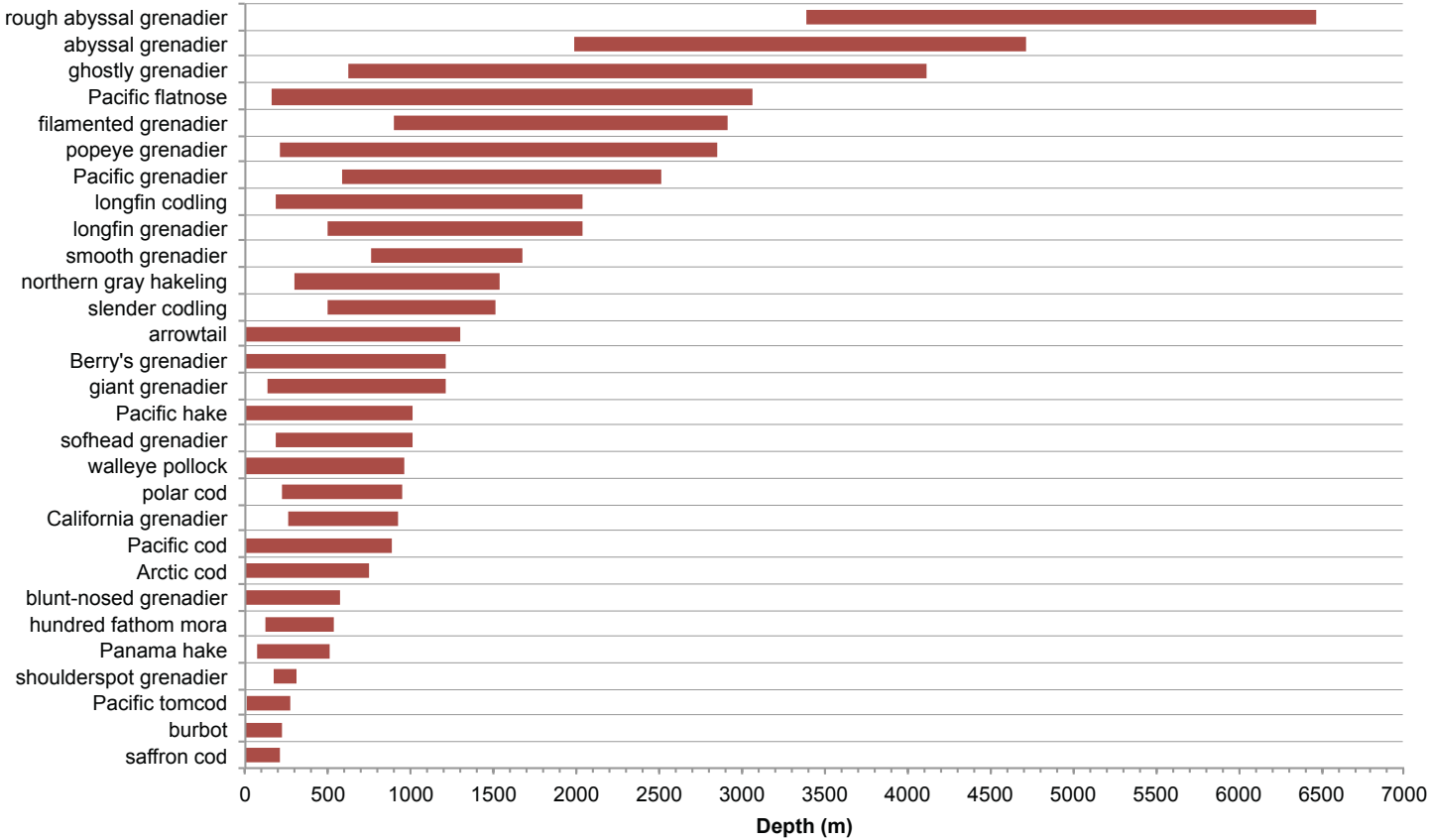
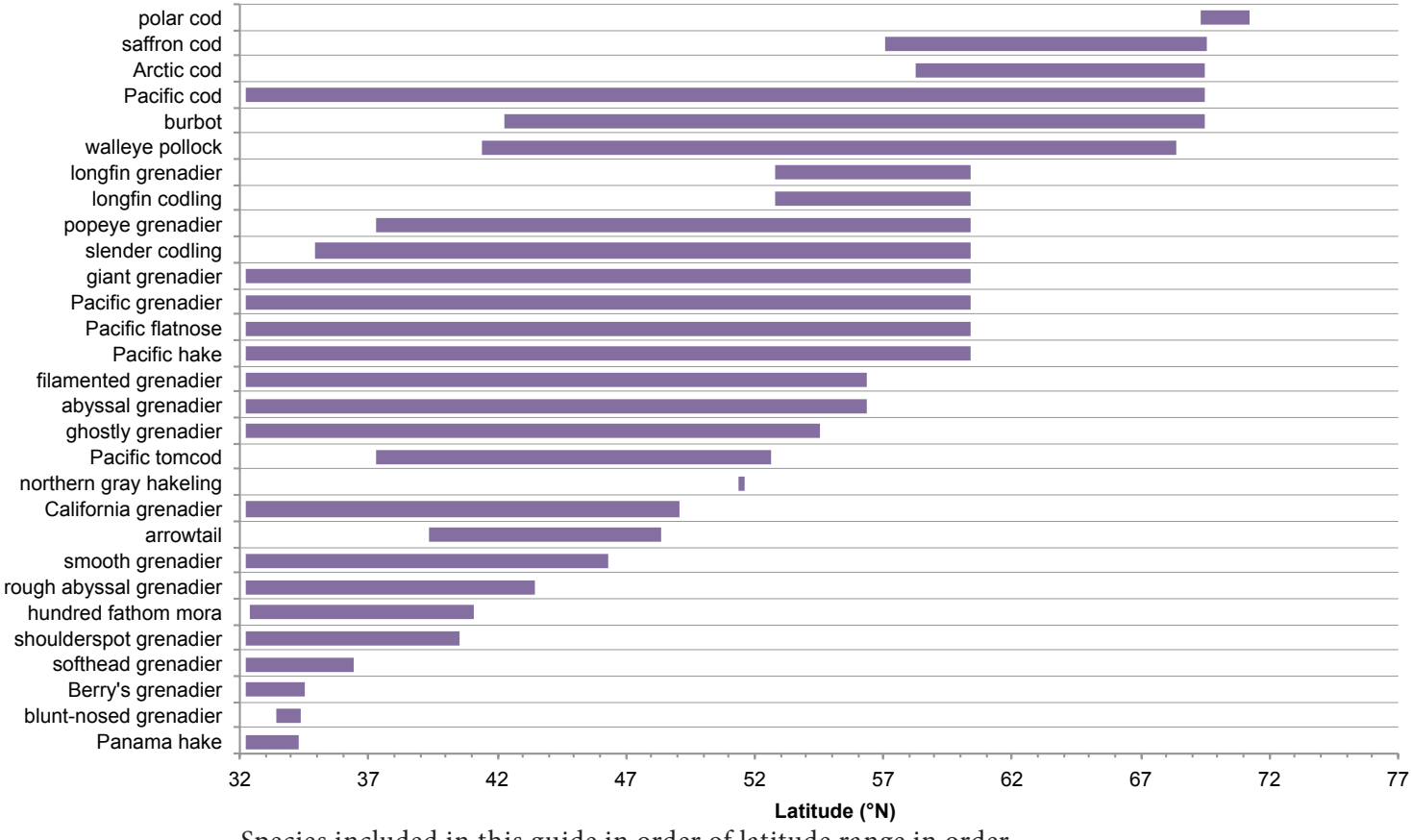


Species included in this guide in order of maximum length from largest to smallest.



Species included in this guide in order of depth range in order of maximum expected depth from deepest to shallowest.



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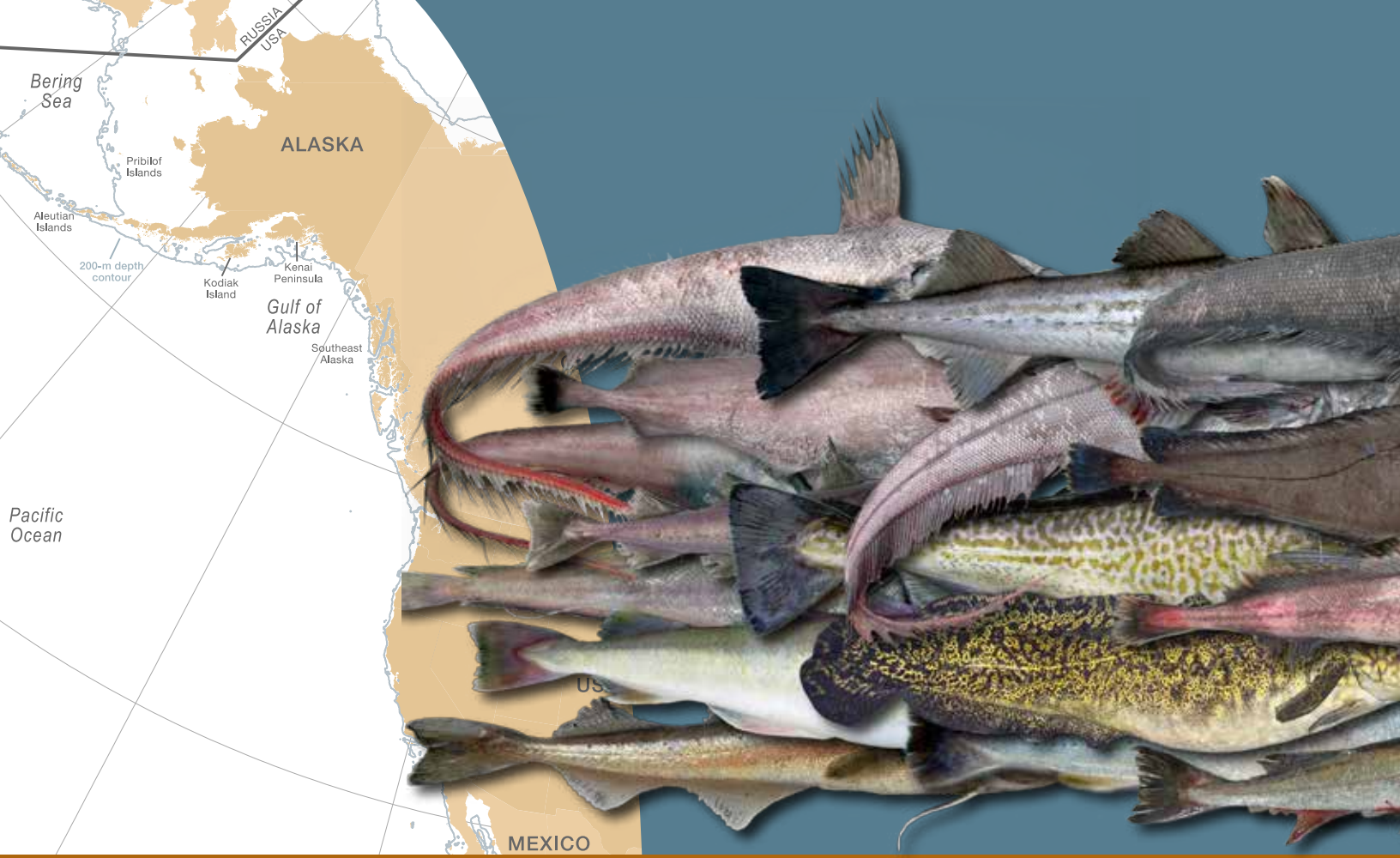
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