



Review of Status of Marine National Park, Jamnagar: Evolving a Vision Statement for Management of MNP

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Review of Status of Marine National Park, Jamnagar:
Evolving a Vision Statement for Management of MNP

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53

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List of Acronyms

BISAG	Bhaskaracharya Institute of Space science and Geoinformatics
BORL	Bharat Oman Refinery Ltd.
CNPPA	Commission on Natural Parks and Protected Areas
CSMCRI	Central Salt & Marine Chemicals Research Institute
DPSIR	Driving Forces-Pressures-State-Impacts-Responses
EEA	European Environmental Agency
GCPC	Gujarat Cleaner Production Centre
GEC	Gujarat Ecology Commission
GEER	Gujarat Ecological Education and Research
GES	Gujarat Ecology Society
GFD	Gujarat Forest Department
GIDC	Gujarat Industrial Development Corporation
GMB	Gujarat Maritime Board
GoK	Gulf of Kachchh
GPCB	Gujarat Pollution Control Board
GSFCL	Gujarat State Fertilizers & Chemicals Limited
HTL	High Tide Line
IOC	Indian Oil Company
IOCL	Indian Oil Corporation Ltd.
IRADe	Integrated Research and Action for Development
IUCN	International Union for Conservation of Nature and Natural Resources
JMC	Jamnagar Municipal Corporation
LTL	Low Tide Line
LU/LC	Land Use / Land Cover
MBRC	Marine Bio Resource centre
MNP&S	Marine National Park & Sanctuary
MNP	Marine National Park
MoEF & CC	Ministry of Environment, Forest & Climate Change
MPA	Marine Protected Area
MS	Marine Sanctuary
NCSCM	National Centre for Sustainable Coastal Management
SAC	Space Applications Centre
SBM	Single Buoy Moorings
SPM	Single Point Moorings
TCL	Tata Chemicals Ltd.

Chapter 1

Introduction

Marine National Park

Marine and coastal areas are one of the highly diverse and productive ecosystems of our planet. Apart from supporting a great diversity of flora, fauna and other natural resources, these areas significantly influence different climate cycles and other global processes. These regions support tourism and recreation industries and play a vital role in the culture, tradition and lifestyle of coastal nations.

However, marine areas throughout the world face serious threats from pollution, over exploitation, conflicting use of resources, damage and destruction of habitats, and other harmful consequences of unsustainable anthropogenic development. The IUCN (International Union for Conservation of Nature and Natural Resources) Commission on Natural Parks and Protected Areas (CNPPA), since 1986, has been promoting the establishment and management of a global representative system of Marine Protected Areas (MPAs) (Kelleher et. al., 1995). A MPA has been defined as “any area of intertidal or sub tidal terrain together with its overlying water

and associated flora, fauna, historical cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment” [Resolution 17.38 of the IUCN General Assembly, 1988, reaffirmed in Resolution 19.46 (1994)]. They occupy 2.8% of global ocean (Figure 1), but provide a plethora of ecological and economical services; Table 1 lists the details of the goods and services. Gujarat Pollution Control Board (GPCB) has identified ten centres to collect samples for analysis.

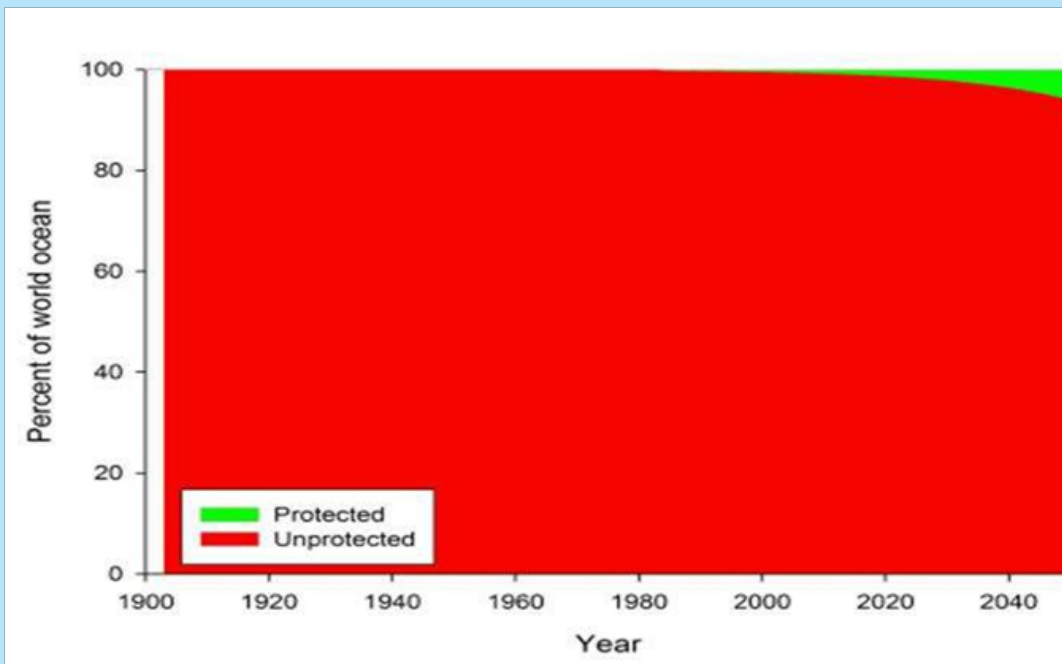
MPAs in India comprised of national park and sanctuaries, with national parks accorded higher level of protection than sanctuaries. These MPAs cover coastal wetlands, mangroves, coral reefs, lagoons, seagrasses beds and other biologically active resources. All the MPAs in the country are notified under the Wildlife (Protection) Act, 1972 and fall in category I and II of IUCN categories of Protected Areas (PAs).

Among the various coastal states of India, Gujarat has the second longest coastline (Rajawat et al., 2015) and is endowed with a bounty of floral

Table 1
Goods and Services Provided by Marine National Park and Sanctuary (MNP&S)

MNP Ecosystems	Goods and Services
Estuaries & Marshes, Mangroves, Lagoons & Salt Ponds, Intertidal, Rock & Shell Reefs, Sea Grass, Coral Reefs	Food (Seafood, plant products etc.)
	Fibre, Timbre, Fuel
	Medicines
	Biodiversity
	Biological Regulation
	Freshwater storage & Retention
	Bio chemical
	Nutrient Cycling & Fertility
	Hydrological
	Atmospheric & Climate regulation
	Disease Control
	Waste Processing
	Flood/Storm Protection
	Erosion Control
	Cultural amenity
	Recreational
	Aesthetics, Ornamental Resources
Coral reefs provide supporting services; sand formation, primary production etc.	

Figure 1
Proportion of the World's Oceans that has been Included in a Marine Protected Area or Reserve Since 1900



Source: Wood et al., 2008

Table 2
Marine National Park (MNP) Profile

Year of Establishment	1982
Location	20° 15' N to 23° 40' N latitudes and 68°20' to 70°40' E longitudes
Area Covered	162.89 sq. km
Districts covered	Jamnagar, Devbhumi Dwaraka
State	Gujarat

Table 3
Total Estimated Annual Value of Benefits from Coral Reefs in GoK

Goods & Services	Total Annual Value (in millions Rs.)	Value Per Unit Area of Coral reefs in GoK (Rs. per sq.km per year)
Fisheries	1284.00	46,40,000.00
Tourism & Recreation	17.80	64,203.00
Protection against Salinity ingression	10.34	37,329.00
Protection Against Coastal Erosion	799.31	28,85,628.00
Maintenance of Biodiversity	88.79	3,20,530.00
Total	2200.24	79,47,690.00

and faunal resources. Two of the three Gulf regions of the country, are lying in the state. The southern coast of Gulf of Kachchh (GoK), in particular, boasts of a diversity of coastal and marine life; and realizing the importance of this zone, the State Government declared some part of this coast as Marine Sanctuary in 1980. In 1982, the area under marine sanctuary was expanded and some of the areas of the marine sanctuary were raised to the level of Marine National Park to provide more protection to these areas. Thus though Marine Sanctuary (MS) and Marine National Park (MNP) are two legal units, they are part of the same ecological area or MPA in the Gulf (Singh, 2003) (Figure 2).

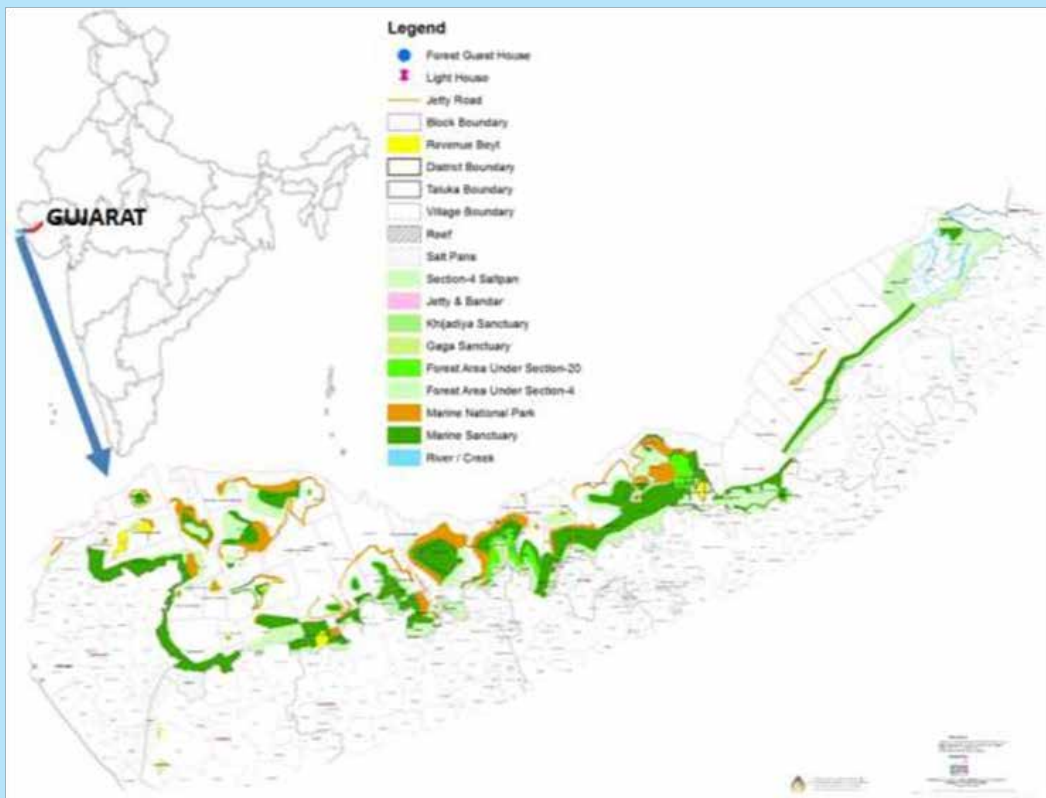
Marine Sanctuary (MS) covers an area of 457.92 sq. km whereas the Marine National Park (MNP) is established in an area of 162.89 sq. km. The MNP is situated along the southern coast of Gulf of Kachchh in Jamnagar and Devbhumi Dwarka districts between 20° 15' N to 23° 40'

N latitudes and 68°20' to 70°40' E longitudes. There are 42 islands, where 37 islands are covered under National park and rest 5 islands are covered under Sanctuary area, Table 2 gives the profile of Marine National Park.

Ecosystem of MNP

The MNP in Gulf of Kachchh supports a variety of marine biodiversity due to availability of a diversity of habitats viz. coral reefs, mangrove forests, sandy beaches, mudflats, creeks, rocky coast, sea grass beds, etc. This diversity of habitats caters to the needs of thousands of flora and fauna species and provides them shelter. We can find variety of floral and faunal species like octopus, jelly fish, star fish, colourful corals, exotic marine flowering plants, puffer fish, sea horse, huge green sea turtles, lobsters, dolphins, etc. at MNP (Table 1). The coral reefs of MNP Area are of immense importance and provide a range of goods and services for the benefit of the people and environment. As per the economic valuation

Figure 2
Location of Marine National Park and Sanctuary (MNP&S)



Along the southern shore of Gulf of Kachchh (GoK) in Gujarat state of India (Source: MNP, Jamnagar)

Table 4
Biodiversity of Marine National Park, Jamnagar

Flora/Fauna	Species
Algae	108
Sponges	70
Corals (Hard & Soft)	72
Fishes	200+
Prawns	27
Crabs	30
Seagrasses	4
Sea turtles	3
Sea mammals	3
Molluscs	200+
Mammals	3
Water Birds	94
Bivalves	92
Gastropods	55
Birds	78

Figure 3
Coastal Stretch between Vadinar and Salaya



Image Source: Google Earth

done by Gujarat Ecological Commission (GEC) for Gulf of Kachchh (GoK) region, the total estimated Annual value of the benefits from coral reefs (mainly in MNP) is Rs. 2200.24 million, detailed values of goods and services are shown in Table 3.

However, this region has also been extensively exploited for human development activities due to strategic location and importance of Gulf. Salt works, thermal power station, fertilizer plant, cement manufacturing unit, offshore oil terminal, soda ash industry, ship breaking yard, ports, jetties – all influence the area overlapping with the limits of MNP&S. In particular, the stretch between Vadinar and Salaya (Figure 3) is an area of intensive maritime activity characterized by three Single Buoy Moorings (SBMs), three oil handling jetties, one thermal power station and one oil refinery, in addition to many source effluent outlets originating from the nearby industries (Devi et al., 2014).

In addition, Jamnagar district has medium and large scale industrial units involved in production of solvents, edible oils, cement, yarn, agriculture equipment, soda ash, salt, and fertilizers. Small scale industries working in Jamnagar are metal industries, food products, rubber, and plastic products. Sectors that have witnessed maximum investments during 1998- 2007 include petrochemical and refinery, fuels and infrastructure projects. Important factors responsible for the industrial development of the district were availability of the resources and port facility in the district.

Thus, MNP and other ecosystems are facing immense pressure due to industrialization, urbanization, tourism, shipping related activities and salt pans. A chronology of the major events that have been experienced by MNP and the area in vicinity of it are listed in the Table below (Table 5):

Table 5
Chronology of Various Events Related to MNP&S

	1909	First marine zoological studies of Okha
Coastal forests along with 31 islands of Okha Mandal notified as Reserve Forests (Notification No. 90 of State of Baroda)	1919	
	1927	Indian Forest Act came into force And Expansion of Okha port
Coral mining started	1930	
	1933	Bedi port became operational
Tata Chemicals Ltd. started operations at Mithapur	1937	
	1940	Digvijay Cement Co. at Sikka became operational
Sikka Port established	1949	
	1950	Kandla Port Trust became operational
Navlakhi Port became operational	1955	
	1956	Mangrove Forest Notification issued by Saurashtra Government
Auction of window-pane oyster fishery	1958	
	1960	Mandvi Port expanded
Gujarat State Fertilizers & Chemicals Ltd. (GSFCL) became operational	1967	
	1969	Fisheries Research Station at Okha was established

Table 5 (Contd...)
Chronology of Various Events Related to MNP&S

	1970	Large-scale destruction of mangrove forests for salt pan areas
Wildlife (Protection) Act came into force	1972	
	1974	Gujarat Pollution Control Board (GPCB) was established
Indian Oil Corporation Ltd. (IOCL) subsea pipeline laid. Single point moorings (SPMs) and Kandla Port Trust offshore terminal became operational.	1978	
	1980	Marine Sanctuary (MS) was established at the Jamnagar coast
Marine National Park (MNP) and Khijadiya Bird Sanctuary were established. Nature Education Camp was started	1982	
	1983	Coral mining banned in MNP and Mangrove plantation started, Cyclone
GSFCL's jetty completed. Ship-breaking and recycling yard at Sachana, and GSECL thermal power plant at Sikka became operational	1984	
	1986	Environment Protection Act came into force
Tata Chemical Ltd. at Mithapur subsea pipeline laid in MNP	1988	
	1989	29th August, 1989 Oil spilled by Merchant Ship at Saurashtra Coast
Coastal Regulation Zone (CRZ) Notification and Sea turtle conservation programme began. 1st Management Plan (1991-2001) was developed.	1991	
	1992	Fisheries Research Station at Sikka established
Mangrove conservation plan was prepared	1994	
	1995	Camel grazing banned in MNP Oil spilled by MC pearl off Dwarka

Table 5 (Contd...)
Chronology of Various Events Related to MNP&S

	1996	Coral mortality reported at Vadinar due to sedimentation
Reliance Petroleum Ltd. at Jamnagar started operations	1997	
	1998	Expansion of Mundra Port, 2 oil spills events off Veraval, destruction of Mangroves due to oil spill, cyclones
Oil spill in GoK: Oil slicks at Narara island off Vadinar Coast, dead dolphins and sea turtles, damaged mangroves	1999	
	2001	Salt brine pipeline from TCL factory at Samlasar running through MNP burst spilling thousand tons of effluent, 8th June 500 tonnes of oil spilled at Vadinar
GoK Granted special status for industrial development	2002	
	2003	TCL slurry pond burst releasing 300,000 T of Calcium Chloride into MPA, 1500 mangrove killed, GPCB ordered closure of TCL soda ash manufacturing plant
Essar Oil Ltd. Refinery at Vadinar becomes operational, Major oil spill (678 T diesel, 4530 lt. lube oil, 790 lt. gear oil & 1022 lt. heavy oil) in GoK due to collision between MV APL Puscan and	2004	
	2005	Sea turtle hatchery at Madhopur established Pilot programme for coral transplantation began.
Oil Spill	2007	
	2009	Bharat Oman Refinery Ltd. (BORL) subsea pipeline laid in MNP. Adani Power Thermal Power Plant at Mundra Commissioned.
Essar Thermal Power Station at Vadinar operational, MoEF declined proposal of Poshitra port in GoK. ICZM Project started	2010	
	2011	CRZ (2011) Notification amended. On 18th July, 2011; 500 litres of crude oil spilled by SBM at Mundra
Oil Spill off the coast of Samrat and Sikka	2012	
	2013	Ship breaking and recycling activities ceased at Sachana. Eco-sensitive zone declared around MNP&S.

Table 6
Report Structure

Chapter	Topic
Chapter 2	Methodological approach
Chapter 3	Stakeholder Mapping
Chapter 4	Threats and Pressures on MNP
Chapter 5	Ecological Status of MNP
Chapter 6	Policy review on Governance and Management Plans

Objective of the Study

The industrial activities coupled with traditional harvesting of flora and fauna from the realms of MNP&S puts severe constraints on the sustenance and survival of this eco-region. The assessment of pros and cons of this kind of co-existence of ecological and economic hotspots is essential in order to analyse/know-

- Whether the sole objective of MNP&S's establishment is fulfilled despite the fact that there has been a mounting growth in industrial activities in the vicinity of park?
- The advantages of establishing an exclusive Marine National Park.
- How the industries and other stakeholders handled the MNP&S/ How the MNP and other stakeholders (e.g. industries) survived together?
- What has been the role of government in conservation and management of the MNP since its establishment in 1980-82?

The proposed study aims at answering the above points by presenting a macro picture of the

situation. Particularly, the project objectives are:

- To assess the ecological status (biodiversity) of MNP&S before and after its establishment.
- To provide a macro view of the industries' and stakeholders' impact on MNP.
- Propose a vision statement for sustainable and workable management for healthy co-existence of MNP and economic hotspots.

In order to throw light on the changes that the MNP&S has experienced since its enactment in 1980-82, this study has highlighted its ecological status, threats and pressure from various stakeholders and provided a review of its governance and management aspects.

The methodological approach for the project has been explained in the chapter 2, chapter 3 provides details regarding the various stakeholders associated with MNP, chapter 4 deals with threats and pressures on MNP, chapter 5 assesses the ecological status of MNP, chapter 6 provides a policy review on governance and management plans of MNP.

Chapter 2

Framework and Methodology for the Marine National Park, Jamnagar

10

D-P-S-I-R Framework

The Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework is used to explore key contemporary environmental issues for MNP. The DPSIR framework was developed by the European Environmental Agency (EEA) to improve the socio-economic and socio-cultural aspects of environmental reporting.

This framework recognizes the role of economic and human activities in environmental degradation and the capacity for society to manage these impacts. Driving forces are the socio-economic, cultural and political forces that guide human activities and that increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State encompasses quantity, quality, extent and/or condition of the environment, while impacts are the consequences of environmental degradation and/or interventions. The responses refer to the actions undertaken by society to improve, manage, mitigate and adapt to environmental changes.

The DPSIR framework is not a simple linear cause-and-effect framework. As explained in the Global Environment Outlook 4 report (UNEP, 2007), the conceptual framework reflects the key components of a complex chain of spatial and temporal cause-and-effects and the many feedback loops that characterize the interactions between society and the environment. Environmental changes are induced by drivers and caused by pressures, but they do also affect each other. These changes interact with demographic, social, material and other factors in determining human wellbeing. These processes take place at all spatial scales, from global to local (UNEP, 2007). A key purpose of the framework is to assist with informing an effective transition towards sustainable development.

The DPSIR framework is structured to follow causal chains from an indirect root cause ('driving forces' D) to a direct pressure and finally a management response (R) between interacting components of social, economic, and environmental systems, as defined in Table 7. Framework adopted for MNP can be seen in Figure 4.

Table 7
Definitions of The Dpsir Framework with Examples for the Coastal Environment

Variables of the DPSIR framework	Examples
Driving Force: The driving force variable refers to issues on the macro scale broadly and indirectly affecting marine and coastal ecosystems. Driving forces might be considered as 'root causes'.	<ul style="list-style-type: none"> • Environmental: changes in stream patterns • Economic: the dependency of communities on fishing • Institutional: the level of enforcement of laws and regulations related to coastal region management
Pressure: The pressure variable describes the immediate cause of the problem. Pressure is synonymous with threats or causal activities.	<ul style="list-style-type: none"> • The amount of pollution by wastewater • Discharges of waste water, • Solid waste • Sewage discharge, • Variation in fish catch.
State: The state variable describes some physical, measurable characteristic of the environment or social livelihood system.	<ul style="list-style-type: none"> • Status of mangroves, corals, seagrasses, etc. • Chemical composition of the water • Fishing industry and Fish consumption indices.
Impact: The impact variable monitors the long- term or more pervasive impacts of a project or ongoing change. There are socio-economic (livelihood) and environmental impacts.	<ul style="list-style-type: none"> • Socio-economic: incidence caused by polluted water; changes in fishing behaviour; appreciation by tourists. • Environmental: changes in fish mortality; sea warming; physical changes to the seabed
Response: The response variables are policies, actions or investments that are introduced to solve the problem or reduce undesirable impacts.	<ul style="list-style-type: none"> • Social: budget given to environmental education; number of awareness raising campaigns; recruitment of more people in MNP department. • Environmental: changes in fish population dynamics; changes in mangroves, corals, etc. • Economic: the use of more efficient fishing techniques, mangrove plantation, coral security and transplantation, etc. • Institutional: the number of co-management arrangements amongst stakeholders to improve management efficiency to conserve MNP

Source: Integrated Marine and Coastal Area Management (IMCAM) Approaches for Implementing the Convention on Biological Diversity; National Institute for Coastal and Marine Management / RIKZ Coastal Zone Management Centre, the Netherlands

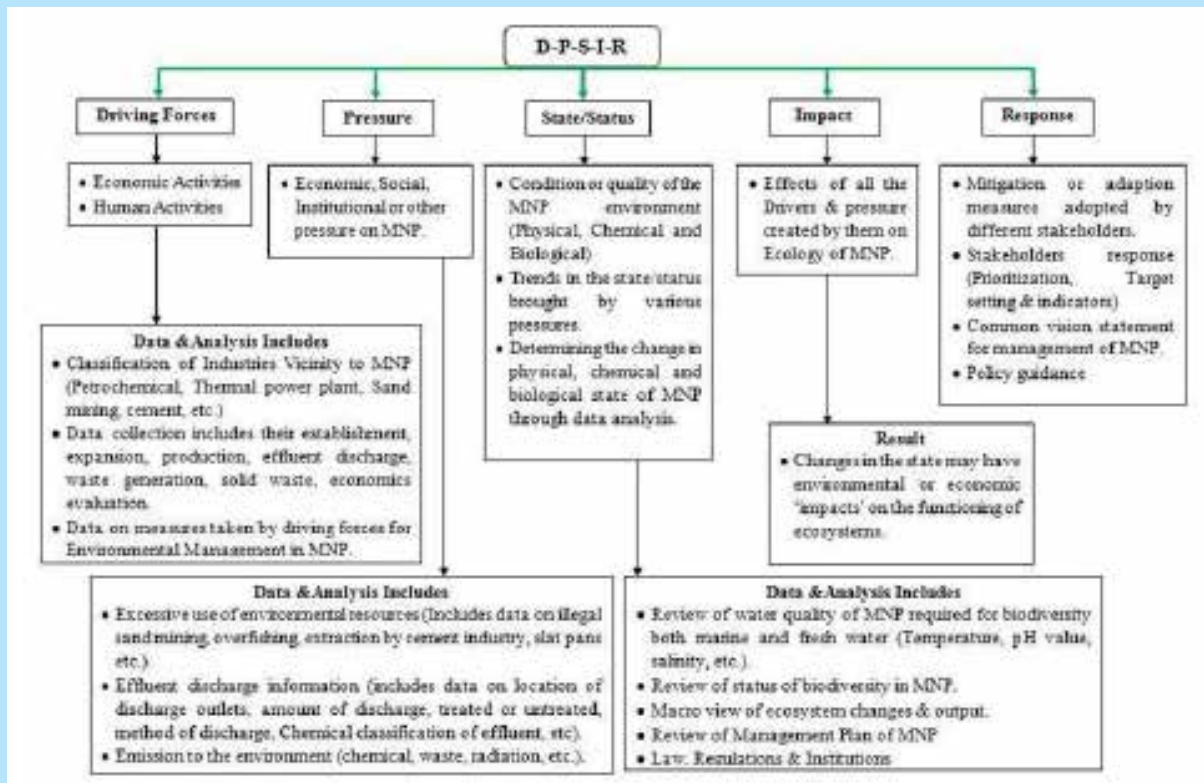
Methodology

Mapping of Stakeholders: Stakeholder mapping was done to identify the relevant actors and their relationships to one another. They are represented in the diagrammatic form (Figure 5) in the context of MNP. Mapping of stakeholders helped in formulating the initial observation about the kind of influence stakeholders have on MNP and provides an overview on the relationships and mutual understanding of the stakeholders towards conservation of MNP. Chapter 2 elaborates more about the stakeholders and their role towards conservation of MNP, Jamnagar.

Stakeholders Assessment and Their Perception Towards Marine National Park

Methodology also includes the assessment of stakeholders' impact on MNP. A macro- view of the stakeholders was done especially of industrial sectors, fishermen, etc. who have affected MNP in one way or other. Assessment included type and number of industries/stakeholders that exist around and within the MNP, sector specific industrial/stakeholder's (refinery, shipping, salt pans, ports/jetties, fishing etc.) practices; nature and volume of pollutants released by them. The data related to large, medium, small industries and on polluting and non-polluting industries

Figure 4
Framework Adopted for Marine National Park Study



was collected and analysed. Data collection was done by means of interviews and Focused Group Discussions (FGDs) with all the possible sources-government departments, forest departments, pollution control boards, research organizations, industrial representatives and fishing folks to accumulate their perception towards MNP. It has also highlighted the benefits they are accruing from the ecosystems in order to understand about their role and capacity in MNP conservation/ degradation.

Ecological Assessment of MNP

This section comprises of drawing comparative status of the ecological status of MNP now and at the time of its establishment. Assessment was done with the help of data collected from forest departments, other government departments and related stakeholders. A rigorous literature review of history of the biodiversity in the MNP was done to assess its health before and after the establishment of MNP. It is required so as to know whether the MNP's objective of biodiversity

conservation has been met or not and to Figure out the possible impacts of stakeholders on the MNP over the period of time.

Mangrove studies got a tremendous boost by the advent of satellite remote sensing technologies. Remote sensing provides a synoptic and repetitive coverage over an area and it becomes possible to literally look into the 'past' through earlier records. It is also cost-effective as repetitive ground visits prove to be an immense drain in terms of resources such as time, money and labour. In addition, we can 'see' the earth features in 'invisible' part of electro-magnetic spectrum, like by preparing an FCC (False Colour Composite) where the infra-red band is displayed as red.

Review of Governance Structure and Management Plans of Marine National Park

Since the inception of MNP many small scale / large scale industries and livelihood activities have popped up in Jamnagar. It is essential to

know and review the standards and guidelines prescribed by the government for establishment of these industries. Appropriate governance structure along with stringent policies and regulations are imperative to check adverse impact of industries on MNP. In order to know

shortcomings and loopholes in the existing management system, a critical review of MNP management plans was done to understand the extent of conservation strategies set up by the regulatory body towards protecting the MNP.

Chapter 3

Stakeholders' Mapping

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Stakeholders' map is produced to identify the relevant actors and their relationships to one another and representing these in diagrammatic form in the context of MNP. Stakeholder mapping was done as per the defined format of GIZ, where each stakeholder is categorized according to their role.

Graphic elements in the form of circle represent the categories i.e. primary, secondary and key stakeholders. Innermost circle in the map represent the veto players which includes the regulatory body that have a direct influence on MNP. Representation of the stakeholders' map helps in formulating an initial observation about the kind of influence stakeholders have on MNP and provides an overview on the relationships and mutual understanding of the stakeholders towards conservation of MNP. In addition to depicting the stakeholders, the graphical representation in Figure 5 provides an overview of all the stakeholders who are associated with MNP in some or other way. Further, these stakeholders have been segregated into Primary, Secondary and Key stakeholders and Veto players.

Sometimes veto players and key stakeholders are considered as similar because without their support and participation, sustainable management and healthy co-existence of MNP with economic development cannot be achieved.

Relationship Status of Stakeholders for Conservation of MNP

Representation of relationships between the stakeholders (strength of relationship, alliances, cooperation, conflict, etc.) using basic graphic elements like solid lines, tramlines and solid lines crossed by a bolt and arrow. Solid lines symbolise close relationships in terms of information exchange, frequency of contact, compatibility of interests, coordination, mutual trust, etc. Tramlines symbolize alliances and cooperation that are organised contractually or institutionally. Solid lines crossed by a bolt of lightning symbolise tensions, clashes of interest and conflicting relationships. Arrows symbolise the direction of relationships of dominance. Stakeholder's relationships defined in the study as shown in Table 8 and 9 are further explained below:

For Solid Lines

There are many players/stakeholders associated with the area declared as MNP&S in Jamnagar. The primary stakeholders who are going to be affected the most with the activities going in and around MNP&S are the local villagers/communities. These local communities depend heavily on MNP&S resources for their livelihood and sustenance. These local communities have close relationships with the authorities at Gujarat Forest Department (GFD), Gujarat Ecology Commission (GEC) and Department of Fisheries, Government of Gujarat through their respective 'Panchayats'. These three Government institutions are actively engaged in awareness programmes on the conservation and protection of MNP&S resources for the local communities. In addition, these institutions aim at to improving their socio-economic conditions by training them to adopt livelihood options. This would ensure sustainable utilization of natural coastal resources. Panchayats play a crucial role by connecting the rural folks with the Government authorities.

The landward boundary of MNP&S is dotted with a variety of industrial units. These industrial units comprise the key stakeholders which considerably impact the MNP&S. These industries get the non-agricultural land from GIDC (Gujarat Industrial Development Corporation) and JMC (Jamnagar Municipal Corporation). GIDC helps in identifying locations suitable for industrial development as well as building infrastructure (such as roads, drainage, electricity, water supply etc.) for attracting industries to these locations. JMC is responsible for collection and disposal of sewage (after proper treatment). In addition, the industries are also in liaison closely with Gujarat Cleaner Production Centre (GCPC) for capacity development towards cleaner production technologies. Thus industries, GIDC, JMC and industrial associations like GCPC share close relationships with each other for information exchange.

The management plans of MNP&S are prepared by GFD as per the guidelines of Ministry of




Environment, Forest and Climate Change (MoEF & CC). GFD receives inputs for this exercise primarily from Space Applications Centre (SAC), GEER (Gujarat Ecological Education and Research) Foundation, Gujarat Ecology Commission (GEC) and Bhaskaracharya Institute of Space Applications and Geoinformatics (BISAG). SAC and BISAG chiefly provide thematic maps such as those of mangrove and coral cover, Land Use/Land Cover (LU/LC) and HTL (High Tide Line) and Low Tide Line (LTL) demarcations for different years using satellite images and GIS (Geographic Information System). GEC and GEER Foundation also support through ground-based studies. Thus, MoEF & CC, GFD, SAC, GEC, GEER Foundation and BISAG share close relationship with each other.

Monitoring of marine pollution in MNP&S is done by Gujarat Pollution Control Board (GPCB) and Gujarat Maritime Board (GMB). GPCB administers guidelines and monitoring activities for controlling pollution along the coast whereas GMB monitors and regulates marine pollution emanating from shipping activities at ports and provides information about the same to GPCB. Together, they develop and implement plans to control pollution at ports. GFD is also planning to encourage eco-tourism in MNP&S, primarily on Piraotan and Narara Reefs with the support of Gujarat Tourism Department and local contractors.

For Tramlines

GFD actively collaborates with GPCB, GEC, GEER Foundation and other research organizations for acquiring knowledge about the changes happening over the years in MNP&S as well as for developing plans for its more efficient management. The research organizations, actively engaged in research activities associated with MNP&S include SAC, GEC, GEER Foundation, GEMI (Gujarat Environment Management Institute), GPCB, CSMCRI (Central Salt and Marine Chemicals Research Institute), MBRC (Marine Bio Resource Centre), NCSCM (National Centre for Sustainable Coastal Management), IRADe (Integrated Research and Action for

Table 8
Identification of Stakeholders

Identification of the Stakeholders		List of Stakeholders
	Primary Stakeholders: Actors who are directly affected by the project, either as designated project beneficiaries or as they stand to gain or lose power and privilege, or if they are negatively affected by the project in some way.	Local village Communities dependent on MNP <ul style="list-style-type: none"> Fisher folks Farmers Villagers Panchayats
	Secondary Stakeholders: Actors whose involvement in the project is only indirect or temporary, as is the case of instance with intermediary service organizations	<ol style="list-style-type: none"> Brass and metal industries National Centre for sustainable Coastal Management National Institute of Oceanography Gujarat Biodiversity Board Space Application Centre Gujarat Industrial Development Corporation Central Salt and Marine Chemicals Research Institute. Marine Bio Resource Centre Gujarat Environment Management Institute Integrated Research and Action for Development
	Key Stakeholders Actors who are able to use their skills, knowledge or position of power to significantly influence a project are termed as key stakeholders.	<ol style="list-style-type: none"> Oil & Refineries Salt work industries Fertilizer & Chemical industries Cement Industries GEER Gujarat Ecological Commission. M.S. University Saurashtra University Jamnagar Municipal Corporation Gujarat Forest Department Gujarat Maritime Board. Department of Fisheries Ministry of Environment Forests and Climate Change Gujarat Pollution Control Board. Central Pollution Control Board. Indian Coast Guard. Gujarat Cleaner Production Centre (GCPC) Gujarat Tourism Department
	Veto Players: These are the key stakeholders without whose support and participation the targeted results of a project normally cannot be achieved.	<ol style="list-style-type: none"> Gujarat Forest Department Gujarat Maritime Board. Department of Fisheries Local village Communities dependent on MNP

Red: Private stakeholders
Green: Public stakeholders
Purple: Civil stakeholders




Development) and GES (Gujarat Ecology Society). The universities studying MNP&S include: M.S. University, Saurashtra University and Gujarat University.

For Solid Lines Crossed by a Bolt of Lightning

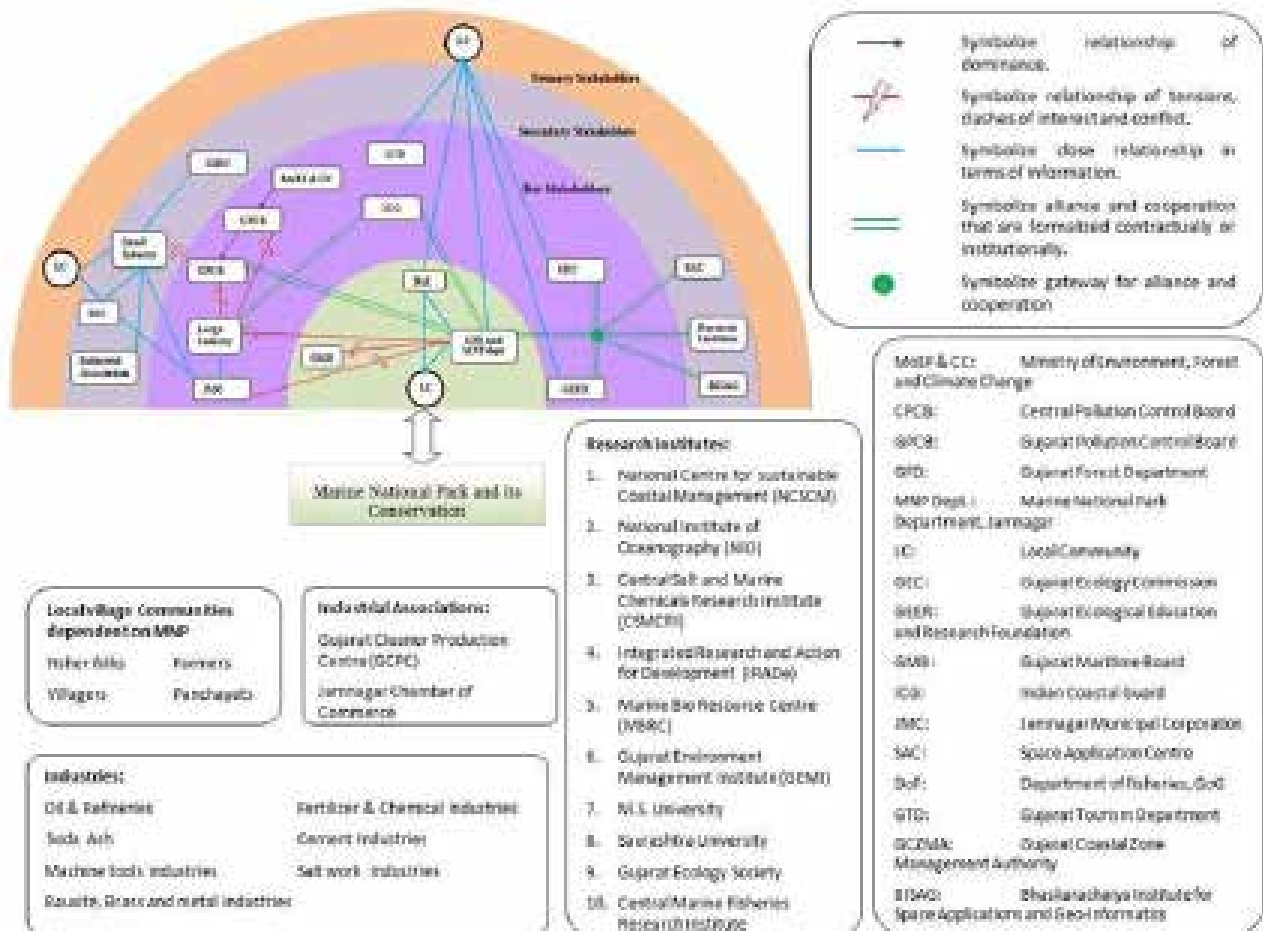
With so many stakeholders, clashes of interest are neither unexpected nor uncommon. For

example, GFD through MNP authorities, prohibit certain activities within MNP&S vicinity with a view to preserve the floral and faunal diversity. However, many times such prohibitions are opposed by industrial players/stakeholders who want to further their interests without accepting their social and ecological responsibility. Similarly, sewage discharged by JMC outlets in

Table 9
Relationship Status of Stakeholders for Conservation of Mnp

	Symbol	Relationship
	<p>Solid line symbolises close relationship in terms of information.</p> <ol style="list-style-type: none"> Local communities have close relations with GFD, GEC and Department of Fisheries. Industries, GIDC, JMC, and Industrial Associations have close working relationship. MoEF & CC, SAC and GFD have close relations with each other. GPCB and GMB have close relations with each other. Village level officers and Panchayats GFD and Gujarat Tourism Dept. 	<ol style="list-style-type: none"> GFD, GEC, and Department of Fisheries provide awareness, orientation and training to the local community and helps in improving their socio-economic condition. GIDC provides non-agricultural land for industrial development. GPCB provides awareness and cost effective training to industries on cleaner production. JMC provides land for industrial development. GFD prepares management plans for conservation of MNP taking into account the guidelines of MoEF & CC. SAC provide remote sensing information and research studies on MNP to GFD, MoEF & CC and Research Institutes as per request. GMB monitors the marine pollution during shipping activities at ports and provides time to time information to GPCB on the same. They together prepare plans to control pollution during shipping activities at ports. GFD and tourism department work together for promotion of tourism in MNP and also prepares guidelines for tourist.
	 <p>Tram line symbolises alliance and cooperation that are formalized contractually or institutionally.</p> <ol style="list-style-type: none"> Research Institutes, GEC, GEER and GFD cooperates each other for ecological conservation. GPCB and GFD 	<ol style="list-style-type: none"> GFD and GEER, GEC and other Research Institutes have alliance between them towards conservation of MNP. They co-operate each other in conducting research studies, monitoring and evaluation of ecology and providing awareness and training to the local community. GPCB also co-operate with GFD in fulfilling the objective of the management plans prepared for conservation of MNP and also legally co-operate them if any industry illegally creates pollution in and around the protected area.
	 <p>Solid line crossed by a bolt of lightning symbolises tensions, clashes of interest and conflict laden relationships.</p> <ol style="list-style-type: none"> GIDC, Industries and Industrial Associations have conflicting relations with MoEF & CC, GPCB and GFD. GFD have a conflicting relation with JMC. 	<ol style="list-style-type: none"> Management plans prepared by conservation department sometimes becomes hurdles for industrial growth and development. However, over exploitation of resources and pollution generated by industries drive conservation departments to take decision unfavourable to industries' interests which bring clashes of interest between them. JMC sewage discharge outlets location is in MNP area.
	 <p>Arrow symbolizes the direction of relationships of dominance/ supervision.</p> <ol style="list-style-type: none"> MoEF & CC with CPCB and GPCB 	<p>GPCB and CPCB work under the guidance of MoEF & CC and submit complete status and information related to pollution.</p>

**Figure 5
Stakeholders' Map**



MNP&S may cause tension between GFD and JMC.

For Arrows

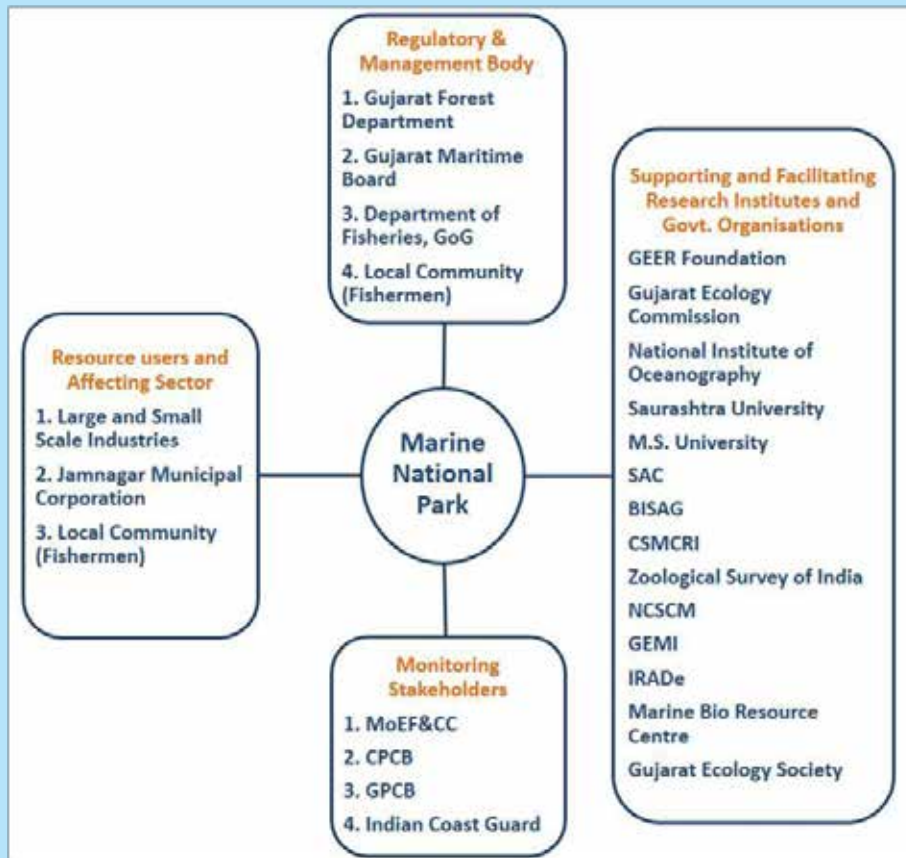
There are few stakeholders who work under the dominance of superior authority for example GPCB and CPCB work under the guidance of MoEF & CC and submit complete status and information related to pollution which shows the dominating relation of MoEF & CC with CPCB and GPCB.

Several authorities involved in management, control and development in the MNP&S are purely maritime in character. Though it is a protected area, a large number of stakeholders are involved in the capacity of conservators, users, promoters, etc. These are the local communities or coastal population, including fisher folks, farmers and villagers or panchayats.

Their livelihood depends on MNP&S, Marine Park Authority, Department of Fisheries, Gujarat Maritime Board, Indian Coast Guards, Indian Navy, Department of Tourism, salt industries, small and medium industries, refineries and other manufacturing companies, such as GSFC Ltd., cement industries and thermal power plants. There is a need for clarity in ambiguous areas and an acceptable legal/ management framework, for achieving the objectives of creating the MNP.

IRADe in consultation with Dr. H.S. Singh tried to evolve a stakeholder's framework to bring out interaction among the various stakeholders. Dr. Singh suggested that since there are many stakeholders associated with MNP&S, they first need to be prioritized based on their involvement in vicinity to the area. Further, it

Figure 6
Stakeholders' Classification as per Their Roles and Impacts



needs categorisation based on their roles and impact on MNP&S under the following heads (see Figure 6):

1. Regulatory and Management Body
2. Supporting and Facilitating Research Institutes, and Govt. Organisations
3. Monitoring Stakeholders
4. Resource users and Affecting Sector

Table 10
Stakeholders Role and Functions

Stakeholders	Role and Functions
Regulatory and Management Body or Veto player	
Dept. of Forest and Environment, Govt. of Gujarat	<ul style="list-style-type: none"> Preparation of Management plan for NP and its implementation. Regulation of activities under IFA 1927, FCA 1980 and WPA 1972. Forest department role is Efficient, Effective and Integrated management of MNP&S. Ensures the Protection, Conservation & development of MNP&S. Internalize the concept of ecological management in development process within multiple stakeholders.
Department of Fisheries	<ul style="list-style-type: none"> Survey and assessment of fish stock Charting fish grounds and monitoring of fish catch to control over fishing. Fisheries regulation, management and conservation Maintaining data and dissemination to other groups.
Local Communities	<ul style="list-style-type: none"> Role of local communities in conservation of MNP&S is really important. They have rich traditional knowledge of ecology of that area and also of different fishing practices. Very well aware about importance of corals and mangroves.
Monitoring Stakeholders	
Gujarat Pollution Control Board	<ul style="list-style-type: none"> Effective implementation of Environmental laws for conservation of MNP&S and to control marine pollution. Monitoring of the generation, treatment and disposal of Hazardous and solid waste through different ways. Water and air pollution control & management
Indian Coast Guards	<ul style="list-style-type: none"> Protection of the coastal and marine environment from marine accidents such as oil spillage, etc. Scientific assistance Team for Coastal accidents.
Gujarat Cleaner Production Centre	<ul style="list-style-type: none"> Technical assistance and dissemination of technology to promote Cleaner Production/Clean Technology in Industries.
Gujarat Industrial Development Corporation	<ul style="list-style-type: none"> Provide land for waste disposal and CETP plants Development of Industrial Park and provide land for industrial development.
Supporting and Facilitating Bodies	
Central Marine Fishery Institute	<ul style="list-style-type: none"> Estimation of Marine fisheries landing and fishery catchment. Taxonomy of Marine organism Marine fish farming Formulate Fisheries Management Plan
Marine Bio-resource Centre	<ul style="list-style-type: none"> Prepare digital data bases of Marine Bio-resources of the state Initiate Bio-prospecting programs Develop a common platform for Linkages within all Stakeholders Create awareness about marine biota
Central Salt & Marine Chemicals Research Institute	<ul style="list-style-type: none"> Efficient utilization of wasteland, sea water, marine algae. Environmental Monitoring and Research and development on marine Bio-resource. Conducts survey on seaweed biodiversity.
Gujarat Ecology Society	<ul style="list-style-type: none"> Knowledge dissemination that enables conservation and restoration Create ecological and environment database Identify coastal environment issues.
GEER Foundation	<ul style="list-style-type: none"> Initiates and facilitate scientific researches & studies Monitoring and evaluation of MNP&S and its biodiversity. Advocacy for judicious and scientific management of Natural resources.
Space Applications Centre (SAC)	<ul style="list-style-type: none"> Thematic area mapping of ecology of MNP&S such as mangrove and coral cover, etc.

**Table 10 (Cntd...)
Stakeholders Role and Functions**

Stakeholders	Role and Functions
Bhaskaracharya Institute For Space Applications and Geo-Informatics (BISAG)	<ul style="list-style-type: none"> Land Use/Land Cover (LU/LC) and HTL (High Tide Line) and Low Tide Line (LTL) demarcations for different years using satellite images and GIS (Geographic Information System) of MNP&S.
National Institute of Oceanography	<ul style="list-style-type: none"> Conduct research on coral transplantation. Knowledge generation and dissemination on ocean Research and development support Consultancy support to stakeholders
National Centre for Sustainable Coastal Management	<ul style="list-style-type: none"> Integrated management of coastal and marine environment for livelihood security, sustainable development and hazard risk management by enhancing knowledge, research and advisory Support, partnerships and network between stakeholders and Coastal Community Interface.
Integrated Research and Action for Development	<ul style="list-style-type: none"> Policy research and analytical support for management of MNP.
Gujarat Environment Management Institute (GEMI)	<ul style="list-style-type: none"> Guidance support to industries for cleaner production. Suggest locations to discharge the hazardous waste and effluent after research. Environmental audits of industries.
Gujarat Ecology Commission (GEC)	<ul style="list-style-type: none"> Support restoration and conservation of all major eco systems and for efficient, effective and integrated management of Gujarat coast Awareness about pollution control among all stakeholders and networking them for participatory and proactive action for formulation and conservation. Community engagement.
Zoological Survey of India (ZSI)	<ul style="list-style-type: none"> Coral survey and monitoring of the health of the corals in India. Conducts faunal survey of important congregative Bird area of MNP&S and Khijadiya bird sanctuary.
M.S. University, Baroda	<ul style="list-style-type: none"> Coral and mangrove studies
Saurashtra University, Rajkot	<ul style="list-style-type: none"> Floral and faunal studies
Central Salt & Marine Chemicals Research Institute	<ul style="list-style-type: none"> Efficient utilization of wasteland, sea water, marine algae. Environmental Monitoring and Research and development on marine Bio-resource. Conducts survey on seaweed biodiversity.
Gujarat Ecology Society	<ul style="list-style-type: none"> Knowledge dissemination that enables conservation and restoration Create ecological and environment database Identify coastal environment issues.
GEER Foundation	<ul style="list-style-type: none"> Initiates and facilitate scientific researches & studies Monitoring and evaluation of MNP&S and its biodiversity. Advocacy for judicious and scientific management of Natural resources.
Space Applications Centre (SAC)	<ul style="list-style-type: none"> Thematic area mapping of ecology of MNP&S such as mangrove and coral cover, etc.
<p>Resource users and Affecting Sector Use: Crude Oil, setting up of SPMs through MNP, Trawling, Fishing by local fisher folks, Fuel wood dependency, etc. Impact: Chronic Oil pollution due to shipping activities, discharge of oil delivered chemicals, oil spillage, bilge water, leakage from SPMs. Sedimentation, siltation, coastal engineering construction, etc.</p>	
Gujarat State Fertilizer & Chemicals Ltd. (GSFCL)	<ul style="list-style-type: none"> Reuse of treated sewage Implementation of zero process effluent discharge system Environment training and awareness Biodiversity assessment Mangroves plantation in around 100 hectare in MNP&S.

**Table 10 (Cntd...)
Stakeholders Role and Functions**

Stakeholders	Role and Functions
Tata Chemicals Ltd. (TCL)	<ul style="list-style-type: none"> Generated effluent has been reused as raw material in the companies' plant Green plantation in Sacres is planned. (State of Environment report 2008).
Gujarat State Electricity Corporation Ltd., Thermal Power Station, Sikka	<ul style="list-style-type: none"> Effluent treatment plant (N-pit) is provided for treatment effluent. A new sewage treatment plant having with Soil Biotechnology [SBT] for domestic waste water treatment and reuse of treated sewage for gardening. [Commissioned] (State of Environment report 2014).
ESSAR Ltd.	<ul style="list-style-type: none"> Mangroves plantation in around 175 hectares of land. Coral Transplantation and monitoring along with National Institute of Oceanography. Installed ETP with capacity of 1000 m3/hr. Reuse of treated effluent as fire water make up / service water make up / cooling water make up in refinery to conserve the natural resources. Oily sludge from ETP has been disposed at GPCB approves TSDF (M/s, SEPPL, Bhachau, Kachchh) (Statement of Environment Report 2014).
Jamnagar Municipal Corporation	<ul style="list-style-type: none"> Proposed two Sewage Treatment Plant of capacity 70 MLD and 50 MLD in Jamnagar city. Reuse treated sludge for industrial development. Disposal of treated sewage in Rangamati river. City Management.

Stakeholder categories¹

- Primary Stakeholders are the actors who are directly affected by the project, either as designated project beneficiaries or because they stand to gain – or lose- power and privilege, or because they are negatively affected by the project in some other way, for instance if they have to be resettled.
- Secondary Stakeholders are the actors whose involvement in the project is only indirect or temporary, as is the case of instance with intermediary service organizations.
- Key Stakeholders are the actors who are able to use their skills, knowledge or position of power to significantly influence a project are termed as key stakeholders.
- Veto Players are the key stakeholders without whose support and participation the targeted results of a project normally cannot be achieved.

Notes

1. Multi-stakeholder management: Tools for Stakeholder Analysis; Published by Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH

Chapter 4

Threats and Pressures on Marine National Park

One of the major thrusts of the industrial policies of the state has been the achievement of balanced regional growth through expansion of industries in the backward areas. Therefore, it is important to understand the dynamics of industrial expansion in terms of its interface between industries and the specific resource endowments of regions, and the resultant impacts on the environment and regional economy. MNP is spread over mainly in and around Jamnagar and Devbhumi Dwarka district, which is located on the western side of Gujarat state, in the Gulf of Kachchh. This chapter examines the overall industrial development scenario of Jamnagar and Devbhumi Dwarka district in Gujarat and tries to establish outcomes of industrial expansion and related activities in the geographical context of Marine Protected Areas with specific reference to the conservation of MNP and its biodiversity, Jamnagar.

Industrial Expansion and Marine National Park, Gujarat

MNP's surrounding areas of Jamnagar have become the centres of industrial growth and

economic dynamism in Gujarat due to a rich repository of ecological wealth. The unbridled expansion of industries and associated factories surrounding the MNP area pose severe threats to the fragile marine ecosystems as well as the protected environments. By and large, some of these threats affecting the ecosystems of MNP include destruction of mangroves, oil spills, toxic waste and reclamation etc., which became intensified in recent years with the establishment of oil refineries closer to the MNP in Jamnagar.

A summary of the industries development status of Jamnagar, based on the latest available data (March 2015, see Figure 7), reveals that the district has about 17,808 registered SSIs (MSMEs) with investment of Rs. 171957.04 lakhs and employment of 90472 people². Though the SSIs are the major source of industrial growth, this district makes only very small contribution towards the state's industrial growth.

Jamnagar district caters to over 70% of the country's requirement for brass parts supply. There are over 4,500 units involved in

Table 11
Trends in Growth of the SSI Sector in Jamnagar

Jamnagar District	Total		
	Unit Regd.	Investment	Employment
2006-07	96	4660.3	1110
2007-08	323	16320.19	4788
2008-09	429	9691.49	4116
2009-10	484	13674.9	5363
2010-11	710	21725.69	5006
2011-12	822	24507.5	9834
2012-13	1150	35443.42	8487
2013-14	951	28111.65	6484
2014-15	560	7984.38	2812

production of brass parts. Also, Jamnagar is one of the principle inventors for production of tie-dyed fabric (Bandhani) in the State. The major minerals found in the district are bauxite, calcite, limestone, and chalk. Other minerals available in the district include sand, black trap, gypsum and bentonite. Jamnagar is the largest producer of bauxite in the State contributing 96% to the total production and has the second highest reserves in the State with 30% share. Hence, mineral based calcite, bauxite, amery and abrasives industries are well developed in Jamnagar. There are over 17 salt work units in the district, with a coastline of approximately 350 km in Jamnagar and salt is exported to countries like China, Indonesia, Vietnam, Bangladesh, Japan, and Nepal³.

Marine National park and Sanctuary area of Jamnagar has been declared as Eco- Sensitive Zone (ESZ) by the Union Ministry of Environment and Forests⁴.The industries and the Gujarat Maritime Board have also been directed that preventive measures should be taken to ensure that there is no oil spill from any ship or even fishing trawlers. Existing industries such as salt manufacturing units and building units and shipping yards, among others situated along the coast will not be allowed to discharge effluents, slurry and other waste into the eco-sensitive zone. The industries have also been cautioned against leakage of brine water or harmful chemicals into the zone.

Tough regulation of Eco-Sensitive Zone includes following points:

- No new polluting industries shall be allowed to be set up within the ESZ. Non-polluting industries may be considered provided they have a minimum of 50-meter-wide green belt.
- Farmhouses, hotels, resorts and such activities that might lead to unregulated tourism shall be strictly controlled and monitored by the Monitoring Committee.
- No mining and crushing shall be allowed within the ESZ and no major changes in landscape that affect the hydrology and ecology of the region, shall be allowed.
- Felling of trees or forests should be as per the 'working plan' or 'management plan' approved by the Competent Authority.
- Tourism activities shall be as per the Tourism Master Plan which shall emphasize eco- tourism, eco-education and eco-development. They will be prepared by the Department of Tourism in consultation with the Department of Environment and Forests.
- Extraction of groundwater for agriculture and domestic consumption of the occupier of land shall be allowed. Extraction of groundwater for industrial, commercial use shall require prior written permission, including for the amount that can be extracted, from the State Ground Water Board and the Monitoring

Table 12
Possible Major Marine Pollutants and Their Problems

Pollutant	Location	Effects
Petroleum Hydrocarbon	Local Oil spills-operational and accidental and large; spills at SBMs, ship breaking yard and cleaning of vessels.	Mainly mortality of benthos, including corals, mangroves and sea birds, and damage to other marine living resources.
Plastics	Beaches, floating, debris	Aesthetically disturbing, entanglement of animals, ingestion by animals.
Pesticides and related compounds	Local point-sources inputs	Acute toxicity
Sewage	Local outfall and industrial townships	Eutrophication and altered community structure, introduction of pathogens.
Heavy metals	Industrial Outfalls	Mostly sub-lethal effects causing growth abnormalities.
Agricultural washings	Seepage from lands	Eutrophication, algal blooms and accumulation of toxic chemicals.
Thermal effluents	Power plants and industrial cooling water	Warning may eliminate and/or alter existing community structure
Introduction of exotic/ vagrant marine organisms	Ballast and bilge waters of ships.	Drastic decline in resident zooplankton and consequently fisheries of bordering states.
Brine water	Brine water from salt ponds, desalination plants and leakages from pipelines of Tata Chemicals Ltd.	Burning, injuries and death of mangroves and marine life due to very high concentration of brine water.
Leakage of ammonia sulphate and other gases	Export by GSFC Ltd and other industries at jetties	Death of marine life, including fish
Chemicals and spills of export material	Ports and harbours	Degradation of habitat and loss of marine life depending on nature of pollution
Mining of limestone and Bauxite	Coastal villages	Increase in silt load and damage to corals.

Committee. Also steps have to be taken to prevent contamination or pollution of water, even from agricultural activities. Further, the authorities will have to see that no untreated or industrial effluent is allowed to be discharged into any water body or on land within the ESZ.

- Other restrictions include those imposed on the use of plastics, noise pollution, solid wastes disposal, and protection of natural springs within the ESZ.

Marine Pollution

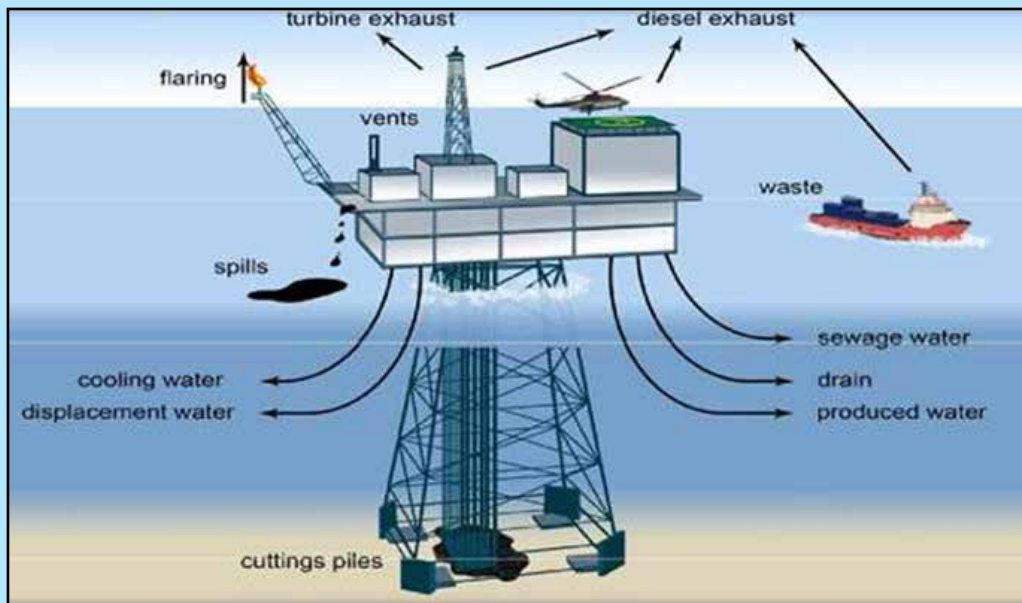
Post liberalization, increase in industrial establishment vicinity to Marine National Park, Jamnagar deteriorated the marine ecosystem. Development activities and industries which are affecting the ecosystem and environment of the marine area are Petroleum and petrochemicals, chemicals, cement, thermal Power stations,

ports, ship breaking units and salt works. Source of marine pollution in major term includes:

1. Disposal of sewage, industrial effluents and agricultural waste;
2. Operational and accidental discharge of ship borne pollutants such as oil spills due to maritime accidents, etc.;
3. Ship breaking activities;
4. Intentional discharges of oil or oily waste by pumping of bilges or de-ballasting cargo tanks or from tank washing;
5. Urbanization;
6. Fishery
7. Drainage of land pollutants to intertidal zone in monsoon.

The sustenance of the MNP ecosystem is threatened by the existence of chemicals, cement and fertilizer manufacturing industries, Oil and

Figure 7
Sources of Discharges and Emissions from Offshore Installations



Petroleum refineries, Ship-breaking industries, Salt industries, sub-sea oil pipelines, etc. While land diversion for salt industries has caused destruction of mangrove forests surrounding the MNP, the loss and degradation of coral reefs has been primarily caused by effluent discharge from toxic and highly polluting industries, oil spills and leaks, etc. The infrastructure development activities, such as development of ports and industries, such as oil/ petroleum refineries, cement, fertilizer, salt pans, mining of bauxite, limestone, dredging, shipping and related activities, etc. have also become serious threats to the marine ecosystem and the protected areas. The industries existing and planned along the coast, with their associated urbanization will be releasing their wastewater, in treated or untreated form, to the coastal Gulf (Singh, 2003). Table 12 represents possible major marine pollutants present in industrial waste and problem arises due to them.

The presence of large refineries in the vicinity of protected areas poses constant threat to marine ecosystem of MNP. Besides, anthropogenic activities such as discharge of industrial and municipal sewage, land use, tourism,

maritime transport, offshore oil exploration and production, dumping at sea has also been identified as causing degradation of the MNP environment. Disposal of sewage, industrial effluents and agricultural wastes are the major pollutants entering the sea water in the MNP.

Most of the incidents of oil spills are accounted from the nearby refineries. There are several sources of oil contamination: 1) Operational spillage that takes place due to improperly maintained links in the floating superstructures; 2) Pinhole leakages are unnoticed leakages from pinholes in the pipelines that carry crude from the SBM to shore-based tanks or in product pipelines that transport petroleum products across the Gulf; 3) Accidental spillages are unforeseen spillages that occur, for example, during the transportation of petroleum, pipeline or tanker spills, coastal facility spills, etc. The release of industrial and domestic wastewater from refinery complexes and townships into the sea is another major source of oil pollution.

The average impact of the refineries development on the marine ecology can result during construction phase as well as the operational

Table 13
Oil Spills Recorded in MNP, Jamnagar Since 1982

S No.	Date	Quantity	Type of Spill	Location	Spilled by
1	29 August 1989	NA	NA	Saurashtra coast	Merchant ship
2	24 September 1995	NA	FO	Off Dwarka	MC Pearl
3	1 June 1998	20 tonnes	Crude	Off Vadinar	SBM
4	9 June 1998	NA	NA	Off Veraval	Ocean Pacific
5	8 June 2001	500 tonnes	NA	Vadinar	Not known
6	18 July 2011	500 litres	Crude	Mundra Port	SBM

Source: Baseline data report, 2015 DHI NA- not available

phases. Construction activities such as setting up of SBM, laying of pipelines and establishment of shores facilities such as a port, have potential to increase the turbidity and BOD, apart from the destruction of intertidal ecology due to the physical interferences. The pollution implication during operational phase is related to the leakages during pumping of crude oil through SBM to storage tanks, release of domestic and process waste water, release of cooling tower blow down and discharge from desalination plants, and spillages during dispatch of the petroleum products.⁵

Large Soda Ash plants also got established due to abundant availability of raw material required for production of soda ash and also limestone and common salt. These industries most of the time discharge effluent from the plant to nearby marine area. Many cases of degradation of marine ecosystem due to these discharges from large industries got highlighted in the past. For example, the effluents discharged by Tata Chemicals Limited can be expected to have shot up nearly 30 times, from 330,000 cu m per year in the 1930s to 8,750,000 cu m per year till 2008⁶.

Oil and Petrochemical Industries:

The main threats to the ecosystem of the MNP of Jamnagar are from oil, petrochemicals and allied industries. The coastal oil and refinery facilities, at present, are: crude oil terminal at Vadinar and the Salaya-Mathura pipeline of Indian Oil Corporation, Reliance Petroleum and ESSAR Oil grass root refineries at Moti Khavdi and

Jam Khambhaliya respectively targeted to process together 39 Million Tonnes (MT) of crude oil per annum, the planned Vadinar-Bina overland pipeline of Bharat Petroleum and sub-sea pipeline of Bharat-Oman Petroleum near Narara, the proposed Vadinar-Kandla submarine products pipeline and the Kandla - Karnal cross country products pipeline. All these are being established in the inner-half of the Gulf⁷.

Oil refinery giants like Reliance and Essar are operating in the area with huge plant capacity and these oil companies are allowed to lay oil pipelines right through the MNP. Further, to facilitate unloading of oil from Very Large Crude Carriers (VLCCs), seven Single Buoy Moorings (SBM) are to be anchored along the southern shore of the Gulf, of which four are already in place - one off Narara Bet, two off Vadinar, one off Sikka and three more are being planned. According to Gujarat Ecological Commission (2010) report, import of 40 Million Ton Per Annum (MTPA) of crude oil through the SBMs in the Gulf, has been cleared which will be gradually raised to 80-110 MTPA⁸.

The mangroves around Jindra Island suffered severe degradation due to recurring oil spill incidences in 1999 (Figure 9). An estimated 14.7 sq.km of mangrove cover in south-east of Jindra bet was considerably affected (Navalgund and Bahuguna 1999; Shah et al., 2005).

During a refinery's operational phase, there are several sources of oil contamination: operational

Figure 8
Degradation of Mangroves around Southeast of Jindra Bet



The figure in the left above shows the mangrove around Jindra Island in 1998. The figure on the right highlights the mangrove area degraded (shown in yellow circle) due to oil spill in 1999 (Image courtesy: USGS)

spillages, pinhole leakages, accidental spillages and effluent release.

- Operational spillages take place routinely for an SBM. It is due to faulty handling of SBM operation and improper links in the floating structure. The spillage is difficult to quantify. The increase in the number of SBMs is bound to amplify the risk of operational oil spillages inside or near the PAs.
- Pinhole leakages are leakages from holes in the pipelines carrying crude oil from SBM to shore-based tanks. This is again usually unnoticed since pinholes are difficult to detect.
- Maritime accidents due to collision, fire, explosion or grounding which results in the release of oil, either from the ship or from the cargo tank.

One moderate accidental oil spill at sea or on land is enough to destroy the fragile coral reefs and the associated lush flora and fauna. Due to presence of SBMs in MNP area and movement of oil tankers and ships, the risk of oil spills in MNP is high.

Soda Ash and Salt Work

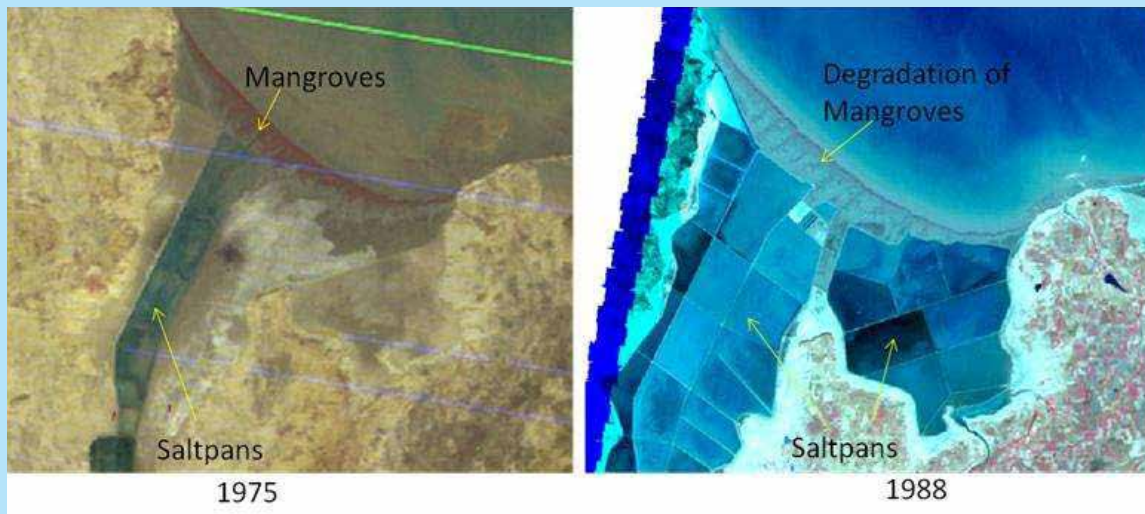
Another significant cause of mangrove destruction was the expansion of salt pans along

the coast (Figure 10). The abundant availability of limestone and common salt, materials required for the production of soda ash and salt, has led to the establishment of giant soda ash plants along the coast at Mithapur, located on the west coast of Devbhumi Dwarka, Gujarat. Notably, for the last 60 years or so, salt works in Jamnagar have been contributing to the state's annual salt production. Large portion of mangrove areas were leased out to industries for the creation of saltpans (Singh, 1994) which took a heavy toll on the ecology of MNP&S. The Government of Gujarat granted lease to 27 salt industries in Jamnagar, but some of these leases were later cancelled. Singh et al. (2002) reported that 21 salt industries are still operational in the intertidal areas.

The Salt pans are characteristically exposed to a wide range of environmental stress and perturbation which manifest mainly through salinity changes. It is reported that 5.2×10^6 tonnes salt is being produced in Gulf annually. It is estimated that $1.1-1.2 \times 10^7$ m³ (kilolitre) bittern of 300 salinity is being released every year, as 1 tonne of salt produces about 1.8 m³ of high salinity of more than 300⁹ unit. In the vicinity of the MNP and Sanctuary, an area of 103.25 sq. km. of mangrove forests is leased

Figure 9

Destruction of Mangroves and Expansion of Salt Pans near Pindhara on the South- western Coast of GoK



In 1975 the area occupied by salt pans was less and the area occupied by mangroves was more (as seen in the figure on the left above) compared to the situation in 1988 (shown in the figure on the right). coast of GoK (Image Courtesy: USGS)

out to 21 salt industries. In June 2001, a total of one lakh mangroves trees died completely due to leakage of brine water from the pipe of Tata chemicals Ltd. near Poshitra and this was the first important case officially recorded against damage at such a scale (GEER, 2002).

The industries produce highly alkaline wastes. The wastewater contains suspended solids, which is released in the Marine Sanctuary area. Due to its high density, the milky white effluent does not mix well with sea water, but instead spreads along intertidal areas or settles in heaps along the shore. The white colour of the effluent is due to high levels of suspended solids: calcium carbonate, calcium sulphate, magnesium hydroxide and silica. The study found that the raw effluent was toxic. Even at 20 per cent concentration, fish did not survive in it for more than 15 minutes¹⁰.

Impact of Urbanisation and Urban/ Municipal Waste on the MNP

High level of urbanization was observed during 1981 in Jamnagar (37.44 %) where the State urbanisation level was 31.1 per cent. During 1991, 2001 and 2011, Jamnagar showed an increase in urban share of population as shown in the Table 14. Increase in urban population

might have been due to either high growth of population in rural areas and out-migration of people from these small taluka towns to large towns within Saurashtra and to other regions of the state¹¹. Rapid industrialization along the coast of Jamnagar is also one of the major reasons behind increase in urban population over the period of time. Further, it has put a lot of pressure with increasing demand of land.

Urban areas of Jamnagar district with increased urban population has put pressure on the marine ecosystem along its coast because of direct dumping of generated sewage, solid waste and waste water. Solid waste and waste water find their way to the sea; at times deliberately discharged into the sea. The ecosystems around the area suffer due to dumping of urban (municipal) waste; and pollution of estuaries and downstream rivers can affect the livelihood of local fisher folks as well.

The various impacts caused by industrial and infrastructure development activities as described above, the MNP areas and ecosystems are greatly threatened by the growing problem of urban (municipal) wastes. In Jamnagar, the Underground Drainage (UGD) system comprises sewer pipes that collect domestic waste water

Table 14
Status of Urbanisation in Jamnagar (1981 - 2011)

Jamnagar	Rural Population	Urban Population	Urbanisation (%)
1981	871484	521592	37.44
1991	932716	630842	40.35
2001	1068022	836256	43.91
2011	1188485	970645	44.96

that are also connected to storm water drains. Storm water and untreated waste water together are thus discharged directly into the water bodies, comprising rivers, streams, lakes and/or and coastal waters. Thus, direct discharge of domestic sewage and waste water into surface water bodies is the main source of surface and groundwater pollution in the state¹².

Jamnagar City has 12 Sewerage zones covering 35 sq. km. Under World Bank funded Integrated Coastal Zone Management (ICZM) project and from State Government funds, currently the works of Sewer collection system with house service connection is under progress which shall cover the entire originally proposed area of 35 Km¹³.

The Sewage from different parts of the City is being collected to the following sewage pumping station:

- i. Gandhinagar Pumping station
- ii. Kalawad gate Pumping station
- iii. Vorna Hazira Pumping station
- iv. Navagham Main Pumping station

The proposed Sewage Treatment Plant of 70 MLD capacity would cater for the population of around 6.3 lakhs till the year 2016. JMC is planning to construct another STP of capacity of around 50 MLD to cover the rest of the left area in and around Jamnagar City.

This project of Construction of Sewage Treatment Plant under ICZM project is funded by World Bank through Gujarat Ecology Commission, being

the State Project Management Unit (SPMU). The project is being executed under DBOT (Design-Build-Operate-Transfer) basis, where most of the treated sewage is expected to be reused by the Operator for industrial application including usage of treated sludge generated from STP treatment. Figure 11 shows details on disposed quantity of treated effluent and generated sludge done by Jamnagar Municipal Corporation during the year 2013-14.

According to GPCB, the Balance treated sewage (apart from reuse quantity) shall be discharged by JMC to the River Rangmati after proper disinfection as per GPCB Norms. The sludge after treatment is reused for horticulture purpose and other industrial applications and balance treated sludge disposed to the JMC's land fill site.

Impact of Ports and Jetties

There is a 355 km long coastline including both Jamnagar and Devbhumi Dwaraka district, wherein nine ports are located. Bedi, Okha and Sikka are intermediate ports while Salaya, Jodiya, Pidara, Bet (Dwaraka), are minor ports. There are many environmental issues associated with increased port development and maritime activity, including tanker spills and accidents, sediment deposition on corals due to deep sea dredging activities and death of marine mammals, like dolphins, porpoise and dugong. The accelerated development of ports and harbours will also greatly increase the problems that fishing communities face, further restricting their fishing grounds and depleting stocks of fish. Figure 12 and 13 shows the locations of ports and jetties in the vicinity of MNP area in Jamnagar.

Figure 10
Treated Effluent and Sludge Generation Disposed Quantity

TREATED EFFLUENT – DISPOSED QUANTITY																		
Sr. No.	Quantity	Years [Quantity in MLD]																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Sewage Input	0	0	50	50	50	50	50	55	55	55	60	60	60	70	70	70	70
2	Reuse	0	0	28	29	33	40	40	42	42	42	50	50	50	55	55	60	70
Disposable Qnt.		0	0	22	21	17	10	10	13	13	13	10	10	10	15	15	10	00

SLUDGE GENERATION – DISPOSED QUANTITY																		
Sr. No.	Quantity	Years [Quantity in MT/Day]																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Sludge Input	0	0	11	11	11	11	11	12	12	12	13	13	13	16	16	16	16
2	Reuse	0	0	2.5	2.5	3	3	3	3	3	3	4	4	5	5.5	5.5	5.5	5.5
Disposable Qnt.		0	0	8.5	8.5	8.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	8.0	10.5	10.5	10.5	10.5

Source: State of Environment Report, JMC submitted to GPCB

Figure 11
Ports Location in Jamnagar and Devbhumi Dwarka



Figure 12
Jetties Locations in Jamnagar



At ports apart from cargo handling, the major environmental activity at port is dredging of navigational channels. The quantum of dredging carried out by various ports in past 20 years is given in the Table below¹⁴:

Table 15
Quantum of Dredging at various ports in MNP

Ports	Quantum of Dredging (m3)
Okha	418175
Bedi	913297
Sikka	15171676

Table 16
Number of Tourists visiting MNP between 1995-96 and 2004-05

Year	National	International	Total
1995-1996	2052	48	2100
1996-1997	2622	52	2674
1997-1998	3317	28	3345
1998-1999	3858	34	3892
1999-2000	6026	2	6028
2000-2001	5728	5	5733
2001-2002	3345	--	3345
2002-2003	8154	3	8157
2003-2004	7922	7	7929
2004-2005	5235	31	5266
Total	48259	210	48469

Tourism

Eco-tourism could be an important source of revenue but more importantly, it leads to pride and awareness among local population and creates a stake in its preservation. It should have a brand value but not be allowed to create excessive physical infrastructure that might lead to adverse ecological impacts.

As per current Management Plan of MNP, a tourism zone and a reef walk path should be created to minimize the damage during the movement of the tourists. Tourism should be regulated so as to allow a particular number of people on a day depending on the carrying capacity of that area. It was observed in the past that the visit to MNP particularly Pirotan island is heavily depending on tide timing as most of the boats are operating from Bedi port which is tidal port. Therefore, on certain holidays when the tide is favourable nearly 4 to 5 hundred people are going on the same day. It is true that everyone going to the island may not go for a reef walk in an entire area but still that may cause some treading and trampling effect on reef. Therefore, the number of people visiting Pirotan Island a day should be regulated¹⁵.

Fisheries

Fishery sector is major source of income of livelihood in and around areas of MNP. Marine

fishing is a key economic activity for large number of people living along the coast; it is operated in 23 fishing centres of the district. Catch of Prawns, Jew fish, Thread fin, Pomfret, Mullet and Crabs dominate the species caught from GoK.

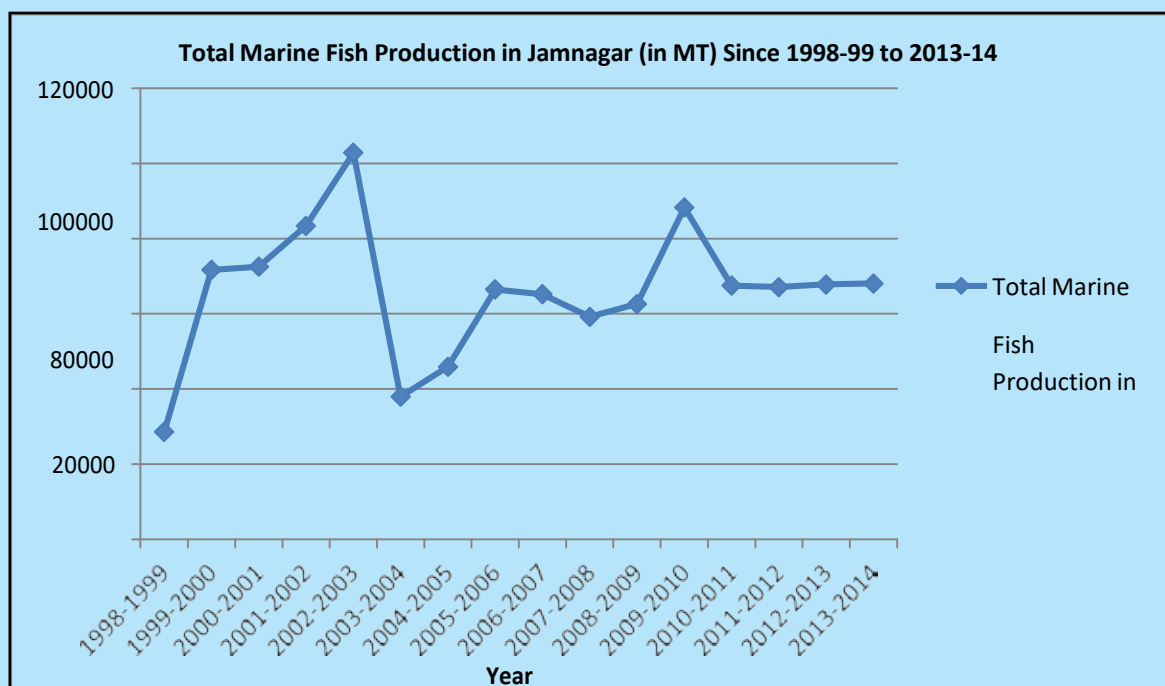
During 2007–2008, total fish landing for Gujarat was 6.77 x 10⁵ tonnes, contributing about 22% of the total production of India of 30.27 x 10⁵ tonnes (*Grinson George, et. al*)¹⁶. About 144 fish species and crustacean's species were reported in the Gulf (Srivastav, 2005). There are about 23 fishing centres like Sikka, Sachana, Salaya, Arambada, Okha, Dwarka, etc. in Jamnagar district which are active in fish catching. As shown in Table 17, during the last 20 years of catch composition, maximum production in coastal area of Jamnagar recorded in 2002- 03 was 102846 MT and it accounted for 13.83 % of the state's production. In year 2001-02 and 2009-10, total fish production recorded was also high in coastal area of Jamnagar, which was 83398 and 88293 MT and 12.85 % and 12.84% of the state's production respectively (Department of Fisheries data, 2013-14) (see Table 17).

The fish species/group wise catch data from 2008-09 to 2013-14 indicate that species like Small Scieneidies, Ribbon Fish, Cat Fish, Seer Fish, Pomfret, Leather Jacket fish, Cuttle/Squids are the major catch of the district (Table 18).

Table 17
Total Marine Fish Production in Jamnagar (1998-2013) (In MT)

Year	Total Marine Fish Production in Jamnagar (in MT)	Total Marine Fish Production in Gujarat (in MT)	% of Gujarat Total Fish Production in Jamnagar
1998-1999	28592	551660	5.18
1999-2000	71683	670951	10.68
2000-2001	72552	620474	11.69
2001-2002	83398	650829	12.81
2002-2003	102846	743638	13.83
2003-2004	37957	609136	6.23
2004-2005	45935	584951	7.85
2005-2006	66489	663884	10.02
2006-2007	65232	676762	9.64
2007-2008	59225	680848	8.70
2008-2009	62618	683855	9.16
2009-2010	88293	687445	12.84
2010-2011	67530	688930	9.80
2011-2012	67146	692488	9.70
2012-2013	67808	693560	9.78
2013-2014	68065	695580	9.79

Figure 13
Trend Showing Total Marine Fish Production in Jamnagar for the Period 1998-99 to 2013-14



Source: Department of Fisheries, Gujarat

Table 18
Species Wise Marine Fish production (in MT) in Jamnagar for the Period 2008-09 to 2013-14

Name of Fish	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
White Pomfret	2931	2296	2088	1041	1403	1816
Black Pomfret	805	1452	535	740	859	668
Bombay Duck	267	98	75	2365	1092	1797
Thread Fin	3181	3119	2633	2421	3152	1439
Jew Fish	2997	1905	2933	2666	2695	1308
Hilsa	10	0	24	27	189	247
Other Clupeids	3031	3254	2543	1461	2945	646
Coilia	15	20	65	262	84	2
Shark	1637	2381	1459	1159	1272	801
Mulletts	945	1044	987	1672	1170	742
Cat Fish	5432	6336	6098	4201	4175	5205
EEL	95	225	307	1184	2235	207
Leather Jacket	4167	4111	2479	822	1185	2800
Seer Fish	6034	74134	4454	5955	5843	3290
Indian Salmon	125	381	258	146	1834	187
Ribbon Fish	2587	3042	4046	3901	2397	6100
Silver Bar	1236	1327	1208	1355	1482	1305
Perch	3063	4505	5219	4549	2251	1873
Small Scieneidies	5523	14884	5819	10608	11883	15873
Shrimps	4949	7791	5459	2712	3131	1510
Prawns (M)	2216	4712	3050	1119	608	455
Prawns (J)	131	242	766	495	491	228
Lobster	112	69	222	113	134	55
Crab	349	404	324	432	412	270
Cuttle/squids	4881	5594	4403	4196	3804	1987
Tuna	54	683	684	785	1309	637
Carangies/Mecarel	310	974	444	384	621	698
Rani Fish	3	27	0	59	1098	191
Sole	32	665	122	721	597	133
Miscellaneous	5499	9340	8829	9592	7457	15597
Total	62618	88293	67530	67146	67808	68065

Source: Department of Fisheries, Gujarat

According to Fisheries department, the mean annual fish production in 2013-14 for species like Pomfret, Thread fin, Jew fish, Cat fish, Lobster, Cuttle/Squids, etc. had decreased (See Table 18 given below).

The catch is widely fluctuating in 17 fish landing centres in Jamnagar district. Among these sites, Okha is the largest one, followed by Bet Balapur and Dwarka (Table 19).

In socio-cultural terms, fishing activity is adopted by communities belonging to different castes. Castes actively engaged in fishing and allied activities are among the Hindu communities like Bhadela, Kharva, Koli, Machhi, Khalasi, Tandel, Mangela, Navik, Kahar, Vaghri etc. and among the Muslim communities like Miyana, Vagher, Machhiara and Ghoghaliya (Economic Valuation of Coral Reefs, GEC, 2010.). According to recent statistics of Fisheries Department, a

Table 19
Marine Landing Centres of Jamnagar

Year	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Okha	36310	62115	41660	37751	32634	33378
Dwarka	2884	4453	4378	5030	6035	4916
Vadinar	393	413	387	479	307	506
Sikka	980	531	230	288	635	321
Jodia	590	542	527	585	390	1054
Salaya	4323	3263	2415	4392	4239	11020
Sachana	1858	1289	1520	1270	1268	1241
Harshad	1213	827	1539	3173	5302	2610
Navadra	1361	2341	1740	3500	3505	2609
Bet Balapur	8966	9874	10761	8293	10553	8229
Bedi	2180	1505	1576	1297	1219	1215
Sarmat	137	141	53	93	878	146
Bed	694	325	324	302	324	268
Nana Ambala	353	348	147	298	252	235
Bharana	261	180	143	261	153	183
Balachadi	116	148	132	132	113	134
Babambha	0	0	0	0	0	0
Jamnagar Total	62618	88293	67530	67146	67808	68065

Source: Department of Fisheries

Table 20
Landing Center wise Fishing Craft used for fishing in Jamnagar

Landing Centre Wise	Trawlers	Gillnetters	Total Mechanized	Motorized	Non- Motorized	Total
Okha	12	23	35	7	61	103
Rupan	1	0	1	712	3	716
Baid	0	4	4	15	14	33
Salaya	187	238	425	2	96	523
Bharana	11	13	24	0	66	90
Jodia	0	34	34	0	2	36
Sarmat	0	1	1	0	11	12
Harshad	0	0	0	117	5	122
Sikka	4	156	160	1	40	201
Bedi	0	175	175	0	31	206
Sacha	0	155	155	0	10	165
Bet-Belapur	0	140	140	4	3	147
Armbadha	0	13	13	2	0	15
Chudeswar	0	0	0	0	15	15
Nana- Ambla	1	26	27	2	17	46
Navadra	0	0	0	80	0	80
Vadinar	0	13	13	0	20	33
Varvada	0	0	0	3	1	4
Jamnagar (Total)	216	991	1207	945	395	2547

Source: Marine Fisheries Census, 2010, Gujarat

total of about 12089 active fishermen (Dept. of Fisheries, Gujarat) earn their livelihood from the fishing activities carried out in the districts of Jamnagar and Dwarka, by using mechanized, motorized and non-motorized boats (Table 20).

Anthropogenic impacts on Fisheries

The last two decades witnessed rampant destruction of coral reefs and mangrove ecosystem due to anthropogenic pressures and climate change (Chittaro et al., 2004; Mumby et al., 2004). Establishment of industries very close to the coast resulted in destruction of flora and fauna, which is closely associated with the spawning and larval rearing cycle of fishes. GoK is famous for its fisheries potential (Vijayalakshmi, 1993). The collective contribution of the Gulf has declined from 21.98 per cent of the total

fish production of Gujarat in 1999-2000 to 18.8 percent of the total fish production of Gujarat in 2007-08 (*Grinson George, et. al) Grinson*¹⁷).

According to many studies based on exploitation of fish, major problems behind loss of biodiversity of fisheries and fall in catches are degradation of ecological support structure such as coral reefs and mangroves, deterioration of quality of coastal waters, overfishing, etc. Central Marine Fisheries Research Institute (CMFRI) indicates that a conspicuous change in resource composition over the years is that the quality fish like Pomfrets, large Sciaenid and Penaeid prawns is being replaced by low value fishes such as ribbon fishes, thread fin breams, carangids, non-penaeid prawns and smaller crabs (Mohanraj, G; et. al)¹⁸.

Notes

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18. Mohanraj, G and Nair, K V Somasekharan and Asokan, P K and Ghosh, Shubhadeep (2009) *Status of marine fisheries in Gujarat with strategies for sustainable and responsible fisheries*. Asian Fisheries Science, 22 (1). pp. 285-296.

Chapter 1

Ecological Status of MNP and S

38

Ecological Status of MNP and S

Ecological Assessment of Marine National Park and Sanctuary (MNP and S)

The MNP&S supports a bewildering diversity of flora and fauna: 7 core mangrove species, 24 species of mangrove associated flora, more than 120 species of algae including some commercially important species of Agarophytes and Alginophytes, more than 70 species of sponges, 37 species of hard and soft corals (including sea anemones), 180 species of fishes, 8 types of sharks, 27 species of prawns, 30 species of crabs, 200 species of molluscs, 3 species of sea snakes, 3 species of sea turtles, 3 species of marine mammals, 94 species of aquatic birds and 78 species of terrestrial birds (Singh, 2000; Draft Notification Marine National Park, Ministry of Environment and Forests, Government of India, 2012) (Table 2).

Annexure-1 provides an overview of the ecological wealth of MNP&S. The list includes many species which are in dire need of protection. As per Singh et al. (2002), 23

algal species, 26 coral species and 6 core mangrove species were classified as either 'Rare' or 'Threatened'. Two core mangrove species viz. *Sonneratia apetala* and *Bruguiera gymnorhiza* have become extinct (Singh et al., 2002). Among the marine mammals, Common Dolphin and Porpoise have been classified as 'Threatened' whereas Dugong has been classified as 'Endangered' (Singh et al., 2002). All the 8 species of sharks found in this region have been labelled as either 'Rare' or 'Threatened' (Singh et al., 2002). Among the turtles, Green and Olive Ridley Turtles are 'Endangered' whereas the Leatherback Turtle is classified as 'Uncommon' (Singh et al., 2002). Among the seagrasses, *Halophila beccarii* was reported to be common while *Halodule uninervis*, *Halophila ovalis* and *Halophila ovata* were very rare (Kamboj, 2014).

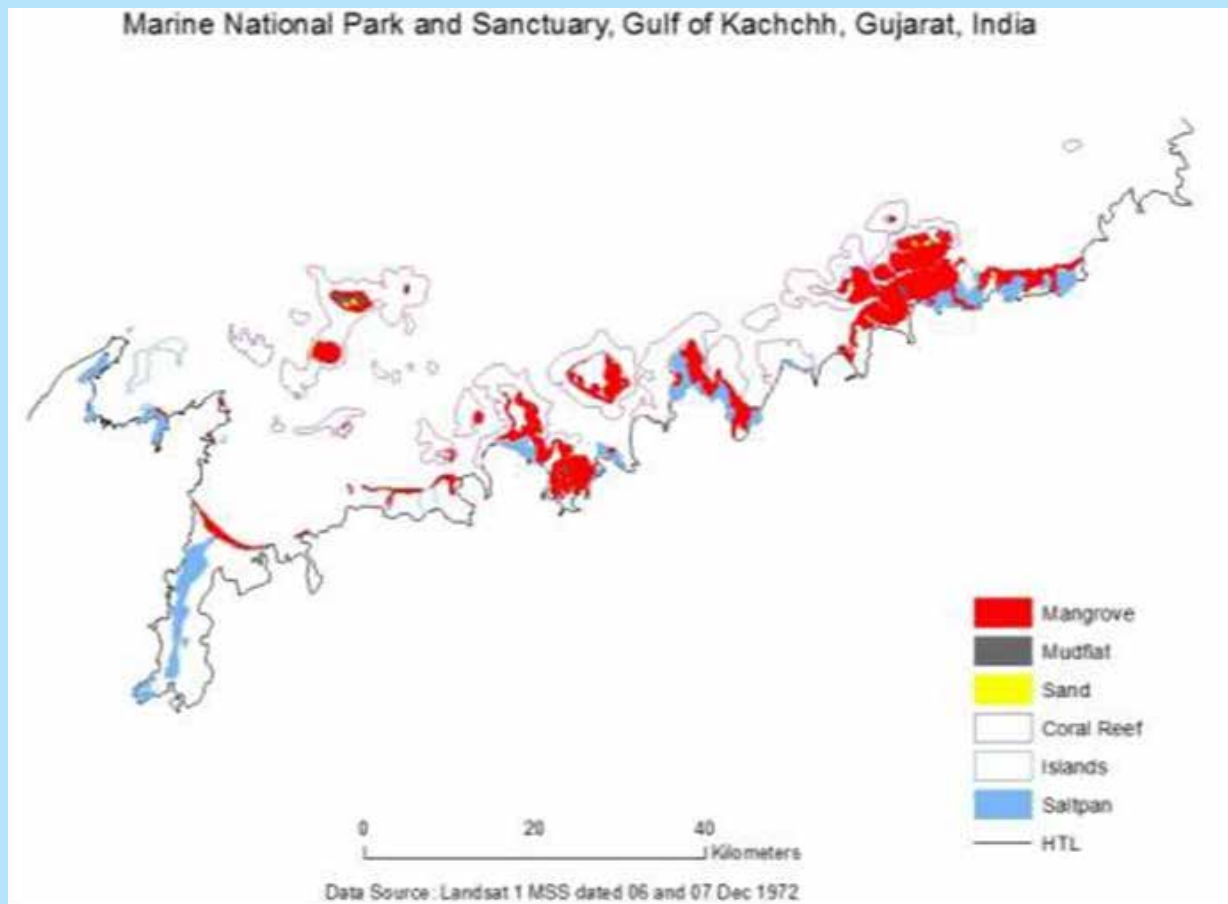
Though the MNP&S comprise of a variety of habitats, two habitats viz. mangroves and coral reefs are relatively more important from the point of view of conservation/protection.

Table 21
Mangrove Notified Area in Jamnagar District

District	Taluka	Area (sq. km)
Jamnagar	Jamnagar	192.88
	Jodiya	105.00
	Kalyanpur	21.50
	Khambhalia	246.35
	Lalpur	20.00
	Dwarka	80.20
	Total	665.93

Source: Singh, 2000; Singh 2002

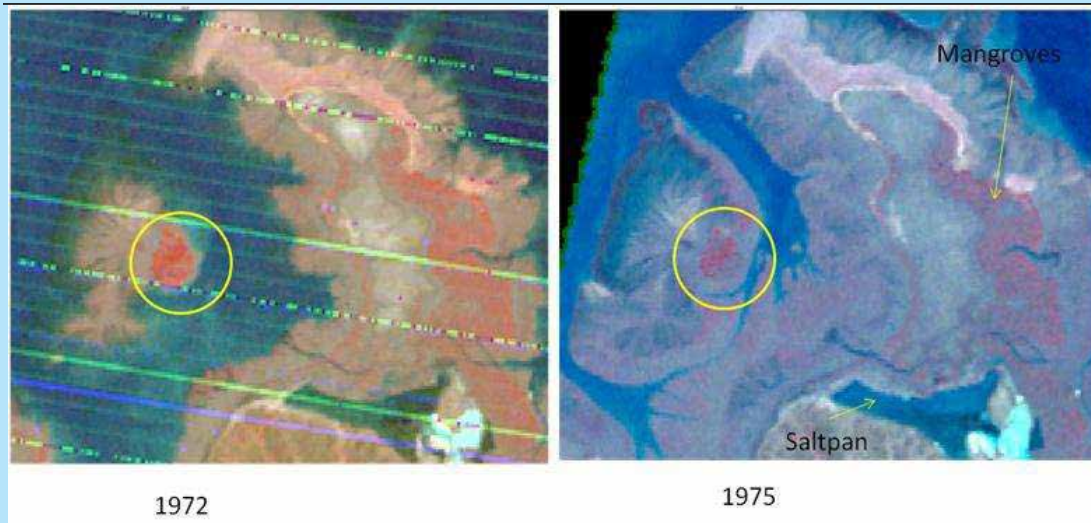
Figure 14
Map of MNP&S Prepared for the Year 1972



Mangroves are one of the most carbon-dense forests of the world whereas coral reefs are called ‘rainforests of the sea’. Degradation of these two habitats impacts directly or indirectly plethora of other species which are dependent

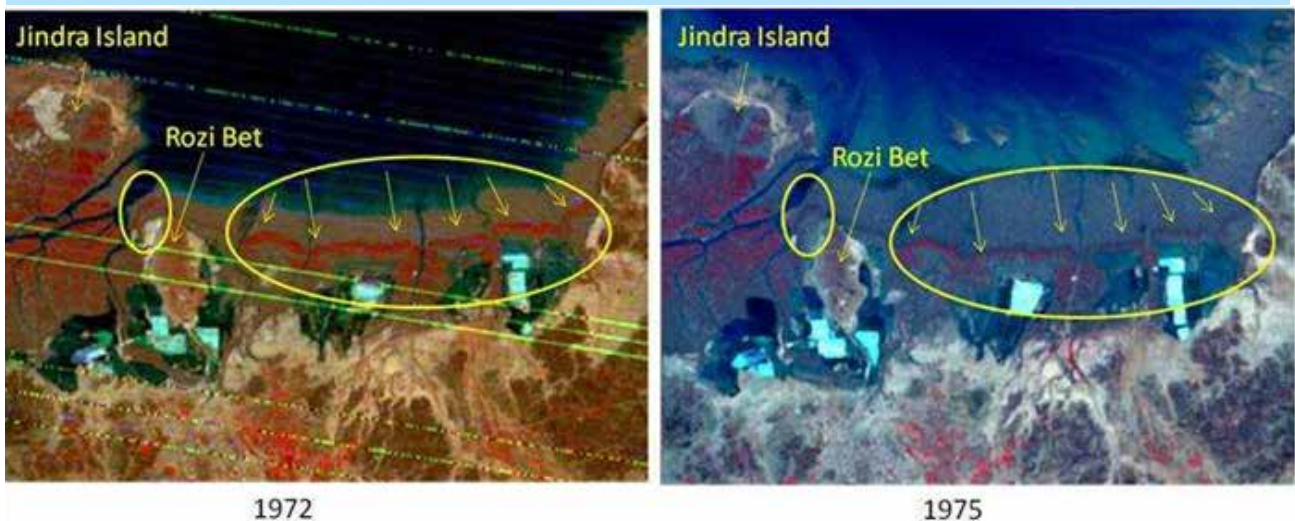
for their sustenance on these two ecosystems. Therefore, the protection of these two habitats is of high priority, without losing sight of importance of other habitats.

Figure 15
Change in Mangrove cover in Gandhiya Kado Island of MNP, Jamnagar in 1975 Relative to 1972



Satellite images represented in FCC where NIR (Near Infra-red) is displayed in Red, Red in Green and Green in Blue (Image courtesy: USGS)

Figure 16
Degradation of Mangroves Fringing the Jamnagar Coast near Rozi Bet in 1975



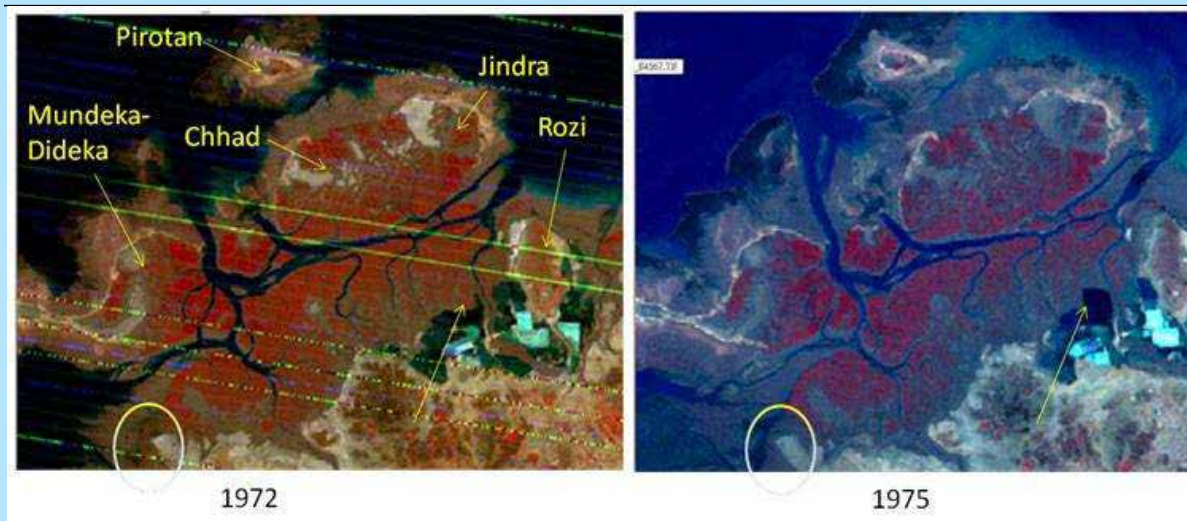
In 1975, degradation of mangroves is observed near Rozi bet (shown by arrows in the right image (Image courtesy: USGS))

Mangroves of MNP&S

Probably the earliest record regarding the mangroves of Jamnagar is the Imperial Gazette of India, Vol. XVIII (1908) wherein it has been documented that Jamnagar (then known as Navanagar State) had mangrove forests along the coastal belt and that these forests were largely used for firewood and pasture requirements (Singh, 2000; Singh et al., 2002). Later the Cher (local name for *Avicennia* sp.;

also used synonymously for mangroves in general in Gujarat) forests of Okha Mandal (including 31 islands) were declared as Reserved Forests vide Notification No. 90 of the Baroda State, dated 24 April 1959 (Singh, 1994, Singh 2000, Singh et al. 2002). In 1955 and 1956, cher forests of Navanagar State were taken over by the Director of Marine Product, Government of Saurashtra and were notified as Forests (Singh, 2000). The Working Plan of

Figure 17
Destruction of Mangroves in 1975 Due to Expansion of Saltpan



The circled area shows destruction of coastal mangroves in 1975. The arrow in the right image shows expansion of saltpan at the cost of mangroves. (Image courtesy: USGS)

Figure 18
Severe Degradation of Mangrove Forests Near Narara Bet in 1988

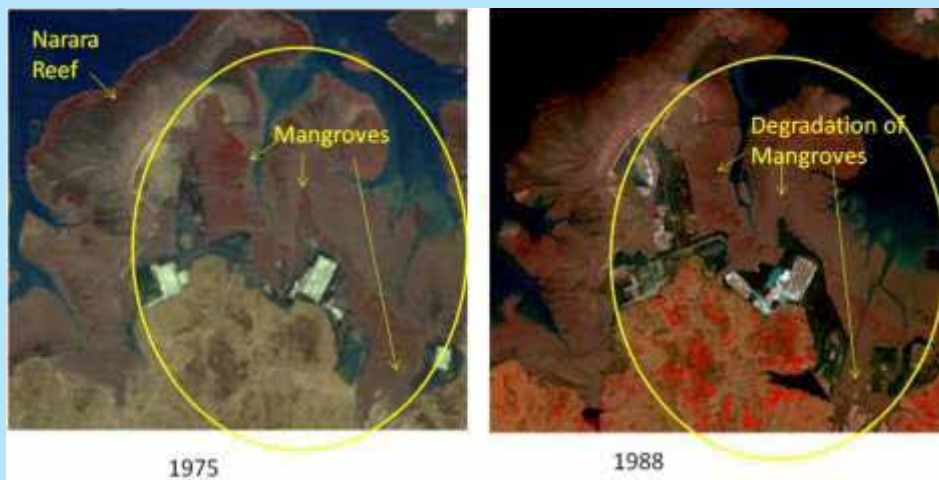


Figure in the right shows severe degradation of mangrove forest in 1988 (in yellow circle) (Image courtesy: USGS)

Baroda (1977) provides the total mangrove notified area in Jamnagar district as 665.93 sq. km (Table 21) out of which 103.25 sq. km area was leased out to 21 salt industries (Singh, 2000).

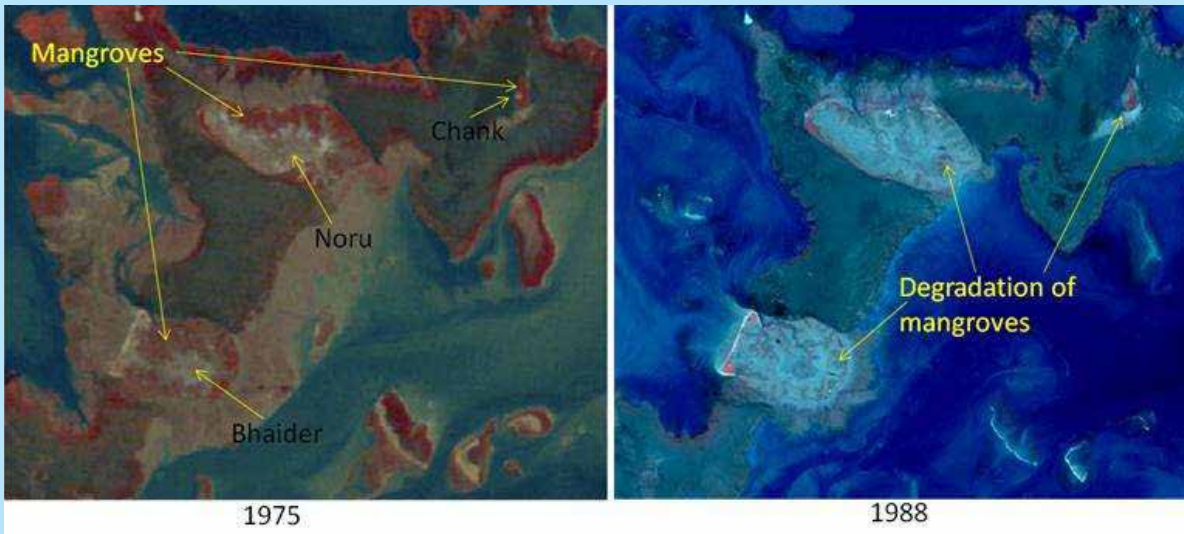
Today, the mangroves in Jamnagar district are under the management control of MNP, Jamnagar (Singh, 2000).

Mangroves along the southern coast of GOK,

in the past, extended from Okha in the west to Navlakhi in the east and continued further upto Surajbari creek (Singh, 2000). They were dense and fairly tall. Overall, they were in good condition though the species diversity was not very high (Singh, 2000).

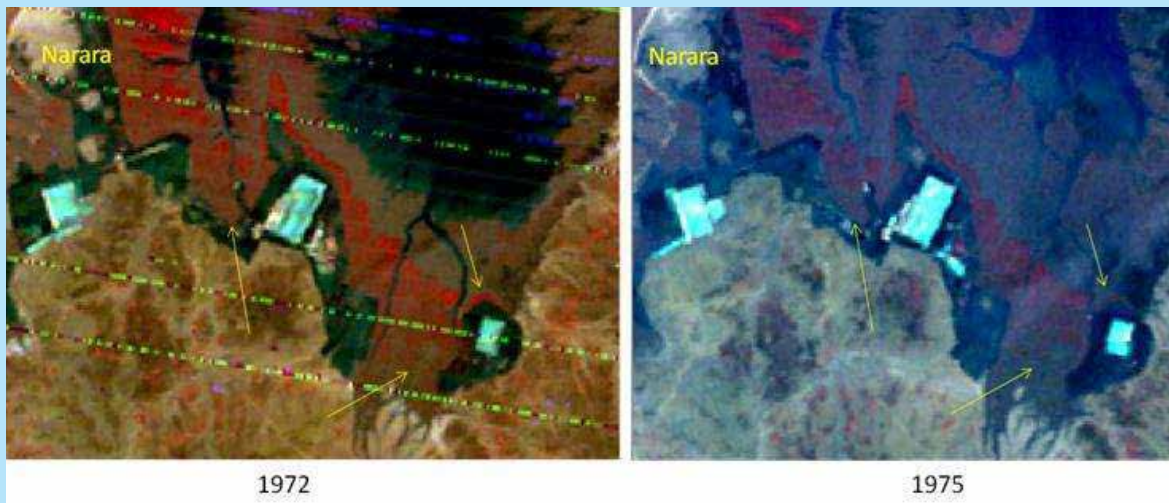
Satellite images of Landsat-1 MSS were used for the year 1972, and the map of MNP&S prepared using these data is shown in Figure 14. For the year 1972, total mangrove area

Figure 19
Heavy Damage to Mangrove Forests of Bhaider, Noru and Chunk Islands



*Degradation of mangroves on the three islands of Bural Chank in 1988 (shown by arrows in the right image)
 (Image courtesy: USGS)*

Fig 19
Damage to Mangrove Forests in 1975 Near Narara Bet



The image in the right shows mangrove destruction along the arrows. (Image courtesy: USGS)

mapped is 175.36 sq. km and the total salt pan area mapped is 65.24 sq. km in MNP&S. The total reef area mapped for 1972 comes out to be 402.14 sq. km. It is pertinent here to note that the images for this region, in particular for the ecological studies, should be selected for the months from October to March. This is because these months support good algal growth on the reefs, which is helpful in assessing the ecological condition of reefs.

Considerable damage to cher forests took place during the period from 1973 to 1976 as these years were marked with drought and the entire coastal belt was declared open for collection of wood and fodder. Much of the mangrove degradation, however, was restricted to the fringing coastal areas, and the island mangroves were relatively less damaged. Some of the mangrove damage captured using satellite images of 1975 are provided in the Figure 15, 16, 17 and 18.

Fig 20
Severe Degradation of Mangrove Forests at Dhani and Gandhiya Kado Islands

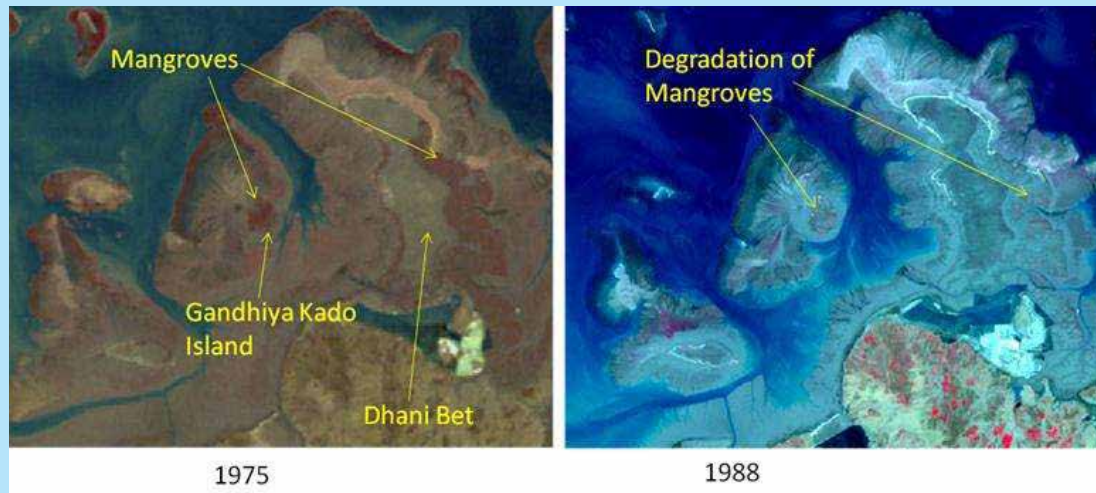


Image in the right shows severe degradation of mangroves in 1988. (Image courtesy: USGS)

Nayak et. al. (1989) used satellite images to map mangroves and coral reefs of a stretch of MNP&S between Rozi and Vadinar, and reported the mangrove cover in 1975 to be 138.5 sq. km. Mangrove cover in this stretch reduced to 50 sq. km in 1982 and then to 33 sq. km in 1985 (Nayak et al., 1989). However, some improvement was reported in 1988 as the mangrove area in this stretch increased to 47 sq. km in this year (Nayak et al., 1989).

The year 1983 saw the initiation of mangrove plantation activities in MNP&S (NCSCM & GEC, 2014). However, during the drought of 1986-88, the restrictions were released, and, grazing and exploitation were allowed which led to significant damage to the ecology of the area (Singh, 1994) (Figure 19, 20, 21).

Mostly mangroves were harvested for firewood and fodder collection by local villagers. The grazing was mostly done by camels which would damage all the leading shoots of the plants and therefore such plants usually didn't grow further and remained stunted (Singh, 1994). These camels (Kharai breed) can even swim in low tides and reach up to nearby islands. Grazing by camels even

damaged pneumatophores. Additionally, grazed vegetation don't produce flowers and fruits, thus their natural regeneration was severely affected.

Another significant cause of mangrove destruction was the expansion of salt pans along the coast. Large portion of mangrove areas were leased out to industries for the creation of salt pans (Singh, 1994) which took a heavy toll on the ecology of MNP&S. The Government of Gujarat granted lease to 27 salt industries in Jamnagar, but some of these leases were later cancelled. Singh et al. (2002) reported that 21 salt industries are still operational in the intertidal areas and in June, 2001 around one lakh mangrove trees were fatally affected due to leakage of brine water from the pipelines of Tata Chemicals Ltd. near Poshitra. Singh (2000) estimated the mangroves in Jamnagar for 1998 as 141.44 sq. km (Table 18). This includes 58.21 sq. km of mangrove cover on various islands (Table 17).

The mangroves around Jindra Island suffered severe degradation due to recurring oil spill incidences in 1998-99.

Table 22
Mangrove Cover (in sq. km) on Various Islands of Jamnagar

Name of the Island	Mangrove Dense (MD)	Mangrove Sparse (MS)	Total (MD+MS)
Dhani	2.55	3.20	5.75
Kalubhar	3.87	5.70	9.57
Narara	2.76	2.73	5.49
Pirotan	0.25	0.14	0.39
Mundeka	6.38	3.35	9.73
Bhaider	3.01	1.76	4.77
Panero	0.14	-	0.14
Ajad	0.03	-	0.03
Jindra	3.67	0.51	4.18
Kodra	0.55	-	0.55
Chusna	0.03	-	0.03
Noru	2.45	2.50	4.95
Chank	0.25	0.03	0.28
Gandhiya Kado	0.50	0.34	0.84
Bhens Bid	1.98	0.17	2.15
Chhad	5.58	3.78	9.36
Total	34.00	24.21	58.21

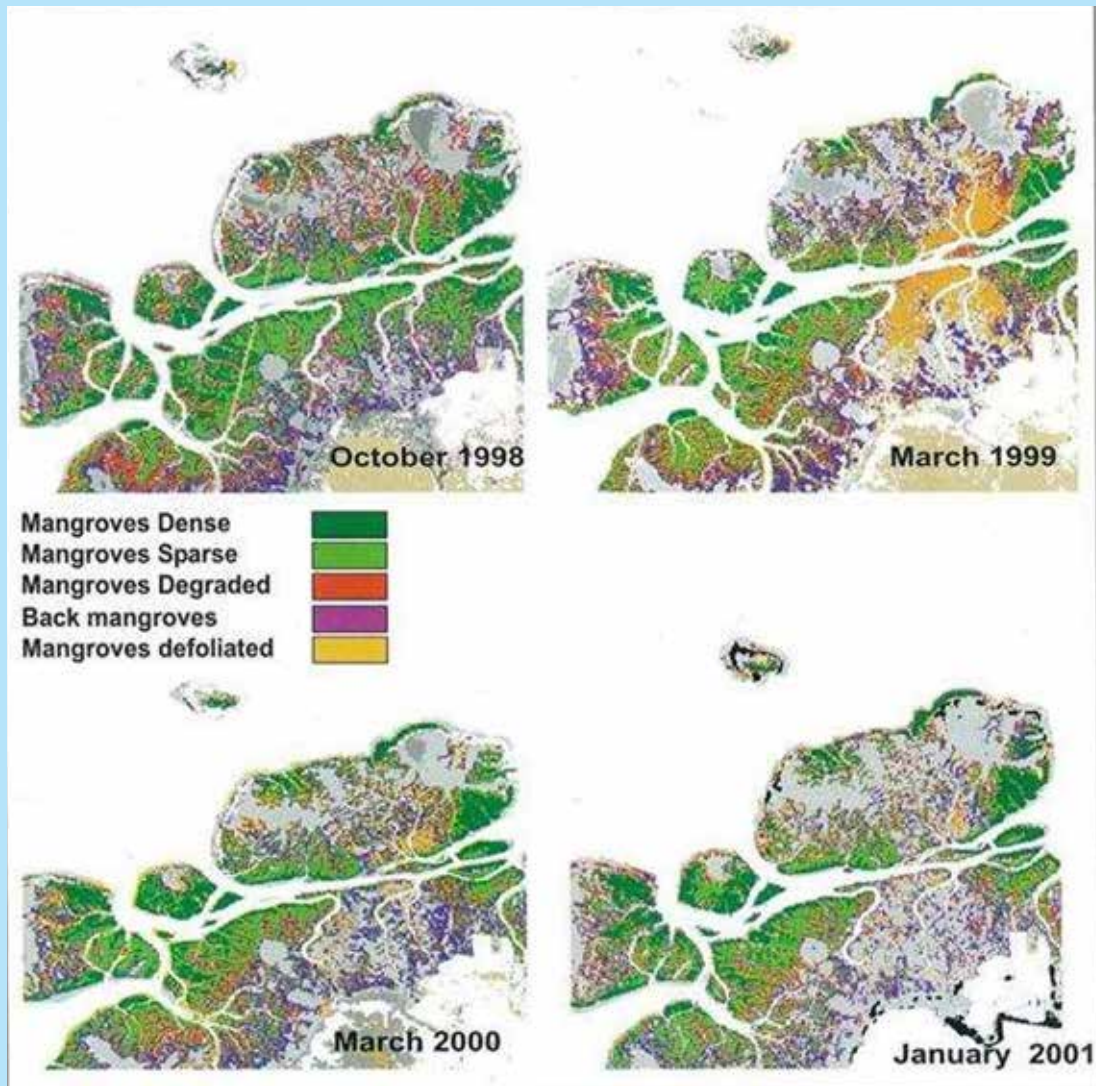
Source: Singh, 2000; Singh, 2002

Table 23
Mangrove Cover (in sq. km) of Various Talukas of Jamnagar in 1998

Taluka	Mangrove Dense (MD)	Mangrove Sparse (MS)	Total (MD+MS)
Jodiya	3.68	14.16	17.84
Jamnagar	32.44	10.99	43.43
Lalpur	5.68	12.69	18.37
Kalyanpur	2.85	0.74	3.59
Islands	34.00	24.21	58.21
Total	78.65	62.79	141.44

Source: Singh, 2000; Singh et al., 2002

Figure 21
Changes in the Ecology of Mangrove Habitat during 1998 to 2001



Source: SAC, 2003a

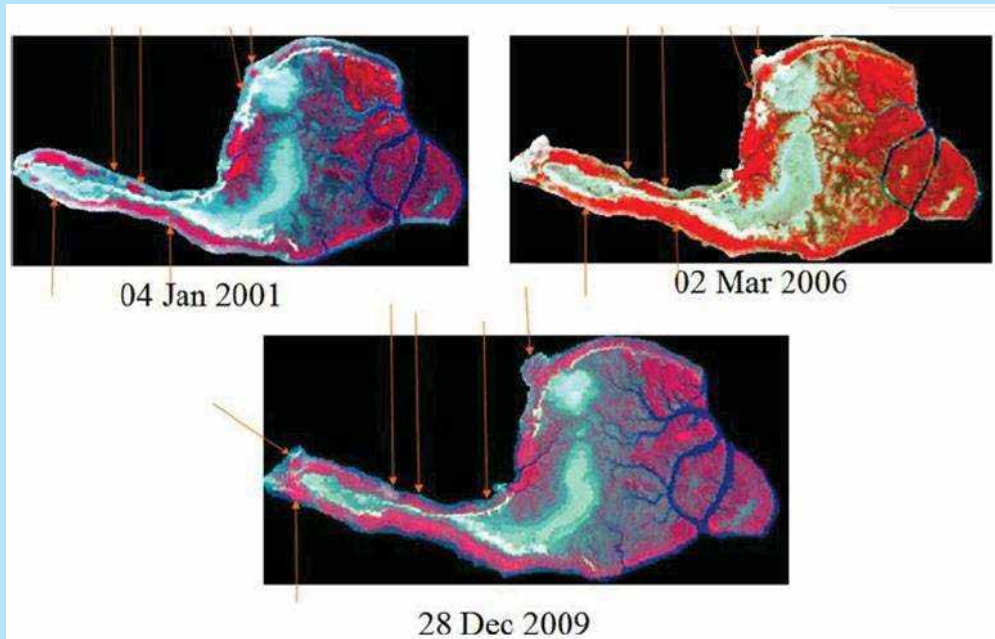
An estimated 14.7 sq. km of mangrove cover in south-east of Jindra bet was considerably affected (Navalgund and Bahuguna 1999; Shah et al., 2005). Space Applications Centre (SAC), Indian Space Research Organization (ISRO) continuously monitored the MNP during this period using the satellite data of November-December 1999, March-November 2000 and January 2001 (SAC, 2003a) (Figure 22). Defoliation of mangroves was reported for March 1999. In November 1999 some improvement was observed, however, there was again a decline in December 1999 and then some improvement was observed in March 2000, November 2000 and December 2001 (SAC, 2003a). The ground survey carried out by SAC

in March 1999 revealed mangroves as standing dead with all leaves shed off (SAC, 2003a). Crude oil coats the root of mangroves which reduces severely the ability of the plant for gaseous exchange.

Long term persistence of the oil lead to loss of leaves (defoliation) leaving the plant “standing dead”.

Mangrove cover increased substantially when observed in 2006 (Kumar et al., 2013). The increase was more in case of sparse mangroves (7.05 sq. km) then in case of dense mangroves (1.97 sq. km) (Kumar et al., 2013). Mundeke-

Figure 22
Consistent Increase on Mundeka-Dideka Island Complex between 2001 and 2009



Increase of mangrove cover (shown by arrows) on Mundeka-Dideka island complex (Source: Kumar et al., 2013)

Dideka islands showed consistent development in terms of mangrove cover between 2001 and 2009 (Figure 24). The area impacted by oil spill (southeast of Jindra bet) was observed under sparse mangrove cover in 2006 (Kumar et al., 2013).

SAC (2012) mapped the mangrove communities of entire nation and calculated the mangrove cover in Jamnagar as 149.62 sq. km using satellite data of 2005-07 period. Mangrove area mapped

by Forest Survey of India (FSI) for Jamnagar district for different years from 2005 to 2015 are as follows:

Plantation of mangroves was initiated in 1983 by the MNP authorities to increase the mangrove cover, and by 2015 an area of 472.44 sq. km (Table 19) of mangroves was planted at various locations within MNP&S. These plantations had been carried out under various schemes such as Cher Plantation, Coastal Border Plantation etc.

Table 24
Area (sq. km) of Mangroves in Jamnagar (as per FSI)

2005	2009	2011	2013	2015
150	157	159	167	173

Table 25
Mangrove Plantation in MNP&S between 1983 and 2015

Year	Area of Mangrove Plantation (in Hectares)
1983-84	7.00
1984-85	1.30
1985-86	4.10
1986-87	17.00
1987-88	250.00
1988-89	236.60
1989-90	102.00
1990-91	150.60
1991-92	466.00
1992-93	600.00
1993-94	550.00
1994-95	701.00
1995-96	1356.00
1996-97	750.00
1997-98	2004.00
1998-99	2403.50
1999-2000	2682.00
2000-01	2880.00
2001-02	3289.60
2002-03	3369.39
2003-04	3452.61
2004-05	1450.00
2005-06	1510.00
2006-07	1600.00
2007-08	2604.00
2008-09	875.00
2009-10	3302.00
2010-11	3346.00
2011-12	2685.00
2012-13	1869.50
2013-14	1320.00
2014-15	1410.00

Source: MNP, Jamnagar

Coral Reefs of MNP&S

Corals are benthic, sessile, marine invertebrates and build a framework of calcium carbonate (known as reef) which provides refuge to many other life forms. The southern flank of GoK is inhabited by northernmost of Indian reefs. These reefs have been classified into fringing reefs, platform reefs, patch reefs and coral pinnacles. The area off the coast of Jamnagar has

fringing reefs around Pirotan, Narara, Dhani and Jindra-Chhad islands, whereas the reef around Mundeka-Dideka, Kalubhar and Bural- Chank are classified as platform reefs. There are also some coral pinnacles observed near Kudda reef and south of Bural Chank reef (Bahuguna et al., 1993). Patch reefs are Paga, Goos and the one around Ajad island (Figure 24). The diversity of corals in this region is quite low due to the

Figure 23
Reefs of MNP in Gulf of Kach



Types of reefs in the Gulf of Kach (Image courtesy: USGS)

geographical location of the reefs, extreme environmental variations (temperature range 15-35°C, Salinity range 25-40 %), strong tidal currents and heavy silt load (Ajai et al., 2012). 56 coral species, including 44 hard corals have been recorded from this region (SAC, 2003b, Singh, 2000). *Ikedella misakiensis*, a rare species of corals which is recorded from only 3 places of this planet, has been found growing in the Gulf of Kachchh (Navalgund and Bahuguna, 1999; SAC, 2003b). *Ikedosoma pirotanensis*, another species of coral has been recorded from Gulf of Kachchh only (SAC, 2003b).

The earliest record of study concerning the corals in the Gulf is probably that of Mr James Hornell who studied corals off the Okha coast in 1909 (Singh, 2000, 2002). The coral mining started in 1930 which led to considerable damage to the biodiversity of the area. Space Applications Centre (SAC) has been monitoring the study area since 1975 using satellite data.

The reef area mapped in the Gulf for the year 1975, 1985 and 1986 was 217.2 sq. km, 179.7 sq. km and 123.2 sq. km respectively (Nayak et al., 1989). A decline of 94 sq. km in reef area was reported between 1975 and 1986 (Nayak et al., 1989). The reefs undergoing significant reductions in area were Bural Chank, Narara and Goos (Nayak et al., 1989). The core area of MNP including Mundeka-Dideka, Jindra-Chhad and Pirotan islands underwent a decrease of 63.5 sq. km between 1975 and 1985. The major reasons assigned for the degradation of reefs were suspended sediment concentration and mining. The latter activity by Digvijay Cement Company was primarily responsible for degradation of Narara reef (Nayak et al., 1989). Mining was later banned as the area was declared a protected area in 1980. Sediments are mainly brought by the mighty river Indus which drains into Arabian Sea near Kori Creek in Kachchh. The sediment layer deposited on reefs chokes coral polyps which result in the death of the animal (Figure 25).

Figure 24
Mud Deposited on Live Corals



Table 26
Area of Reef Categories in MNP&S in 1988-90

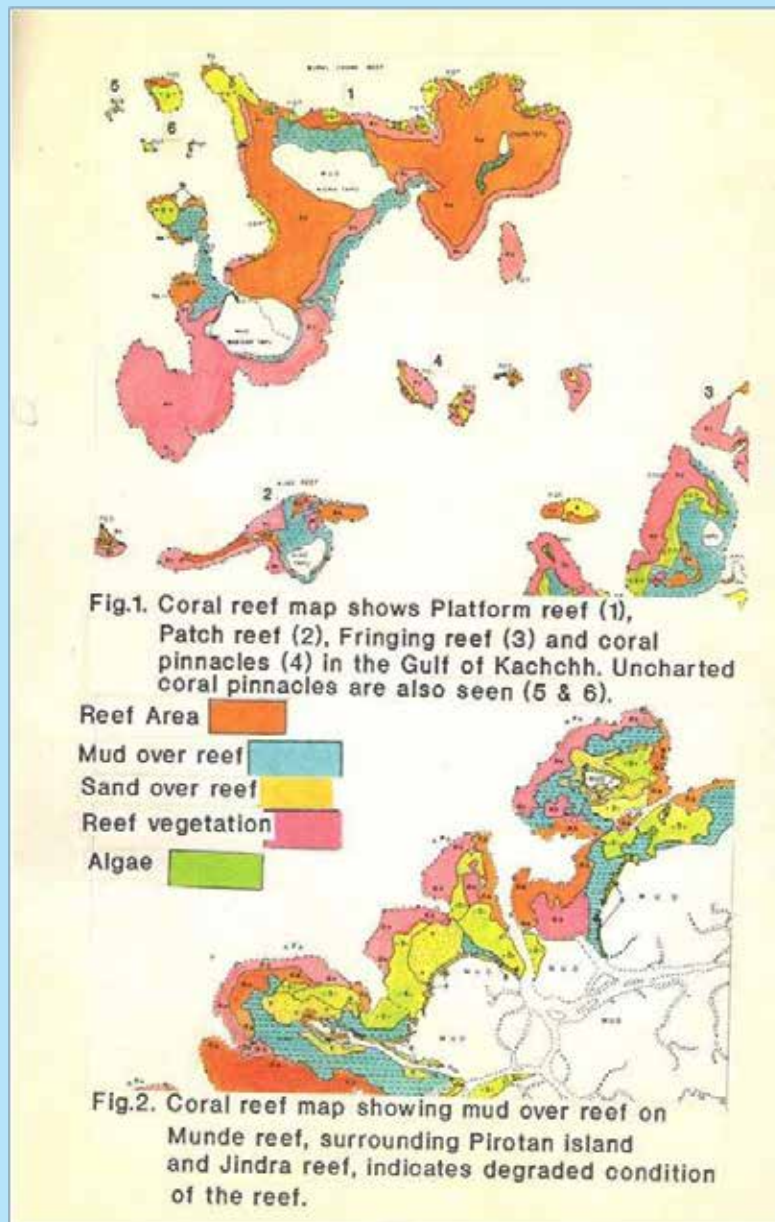
Reef Category	Area (in sq. km)
Reef Area	148.4
Sand Over Reef	11.8
Mud Over Reef	117.1
Reef Vegetation	112.1
Algae Over Reef	53.8
Sand with Vegetation	17.0
Total	460.2

Source: Bahuguna et al., 1993

The condition of coral reefs in MNP&S improved significantly after the area was legislatively protected. Bahuguna et al. (1993) mapped the coral reefs of MNP&S using the satellite images

of 1988, 1989 and 1990 and reported an increase of 23 sq. km in the core MNP area (Figure 26). The various reef categories mapped for entire MNP&S for 1988-90 are (Bahuguna et al., 1993):

Figure 25
Maps of Coral Reefs of MNP&S

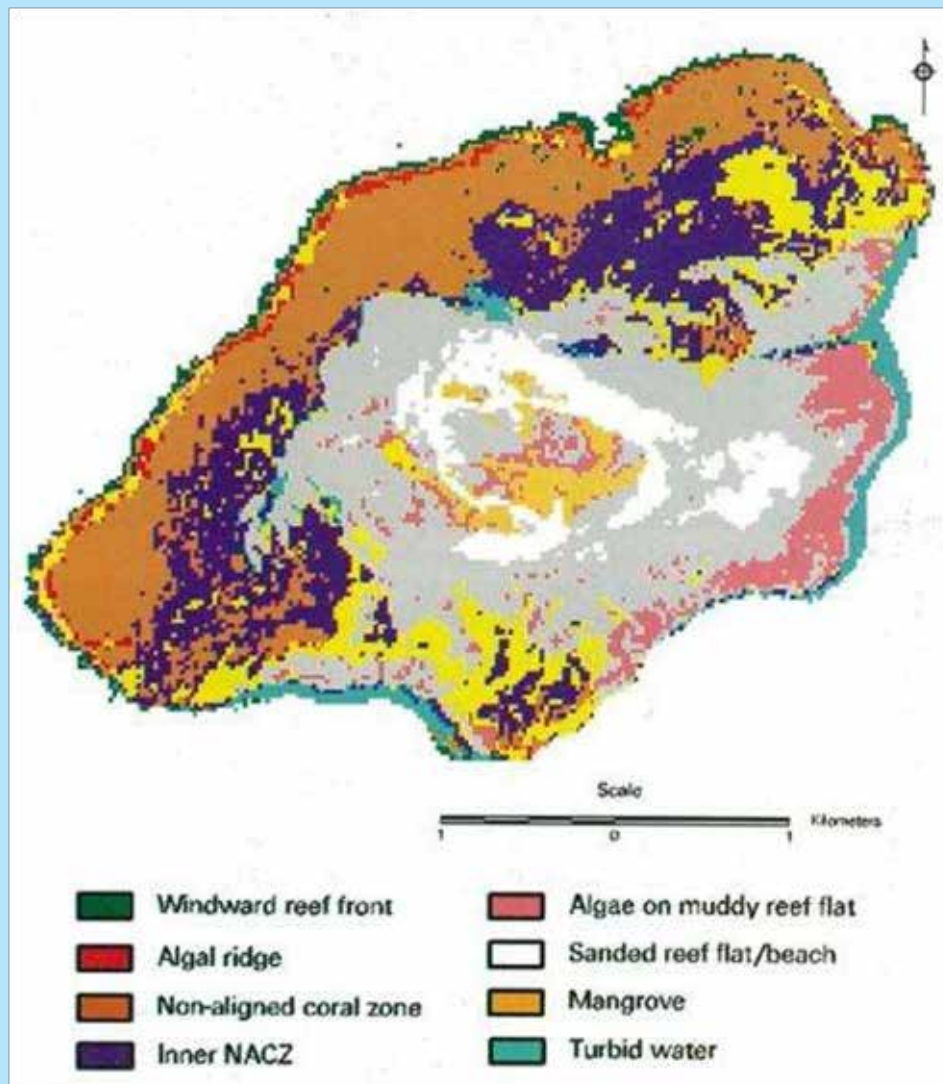


Source: Bahuguna et al., 1993

SAC (SAC, 2003b) did selective mapping of three platform reefs, viz. Pirotan, Kalubhar and Bural Chank using satellite data of 2001 and compared the results with the mapping done using 1990 images. Pirotan reef, located at 22° 35' 03.00''N and 69° 57' 26.2'' E, was supposedly an atoll in earlier times which gradually filled up with mud (SAC, 2003b). It has good reef portion on the north-western, western and south-western side. The reef flat area of this reef showed an increase of 3.9 sq. km in 2001 compared to 1990 (Figure 27) (SAC, 2003b). However, the area of reef flat

declined when mapped in 2006 due to sediment deposition (Kumar et al., 2013). The increase in mud deposition on Pirotan reef was by 2.84 sq. km in 2006 (Kumar et al., 2013). Algal growth was observed on mud depositions on this reef in 2006 and 2011 (Kumar et al., 2013). Adhavan et al. (2014b) conducted a rapid survey of coral diversity on this island and found bleached coral colonies. The possible reasons suggested for this bleaching of coral colonies were increase in the sea surface temperature (SST) and sedimentation (Adhavan et al., 2014). It was emphasized that

Figure 26
Ecomorphological Map of Pirotan Reef Using Satellite Data of 2001



Source: SAC, 2003b

increase in SST was possibly because of delay in arrival of southwest monsoon which resulted in prolonged summer season (Adhavan et al., 2014)

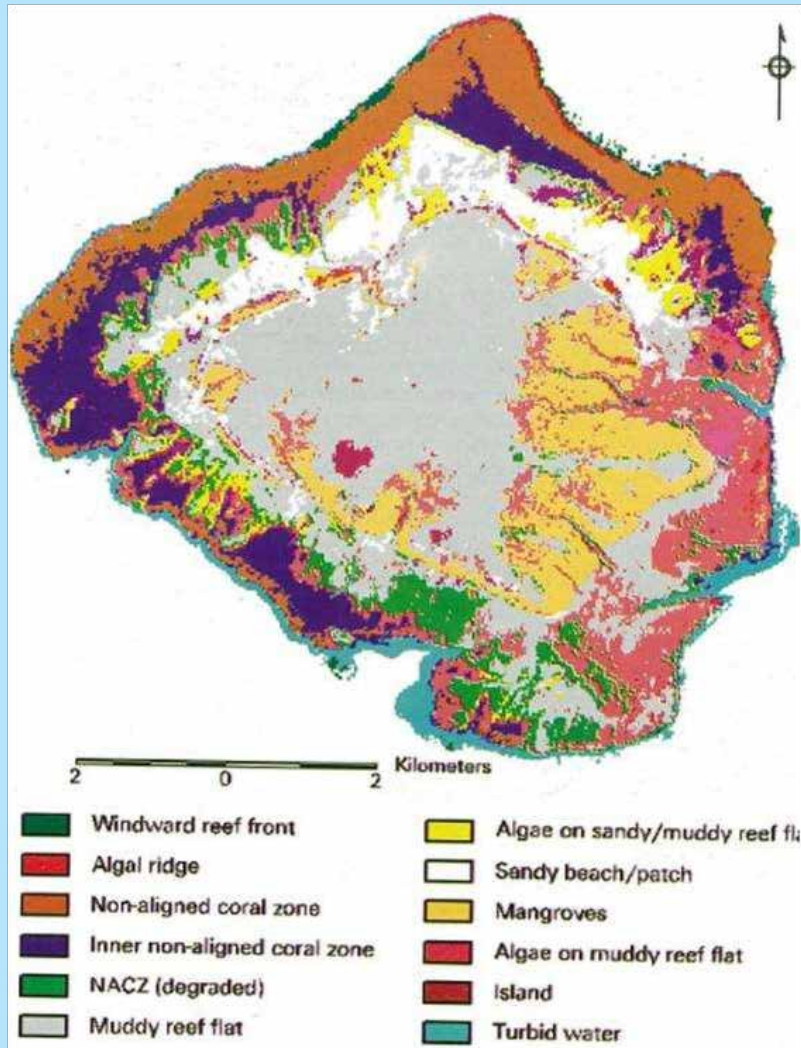
Much like Pirotan, Kalubhar is also speculated to be an atoll in earlier times the central portion of which got filled up gradually (SAC, 2003b).

The condition of this reef deteriorated considerably between 1990-2001 as out of total reef area of 66 sq. km, the probability of finding live coral was reported to be within 8 sq. km only (SAC, 2003b). There was significant increase in “mud on reef” and “algae on mud” categories on this reef in 2001 (Figure 28) compared

to 1990 (Figure 29) (SAC, 2003b). The main cause responsible for degrading the reef was anthropogenic development in the region such as construction of jetty, pipeline, oil terminal and ship-berthing (SAC, 2003b). The infamous oil spill incident of 1999, in fact took place near the southern end of this reef (SAC, 2003b), however the information regarding damage to the reef due to it remain non-existent.

Bural Chank is a conglomeration of five islands, viz. Bhaider, Noru, Chank, Khara Chusana and Mitha Chusana. The latter two are almost indistinct in satellite images, and mostly the mapping is done for the first three islands. The islands are

Figure 27
Ecomorphological Map of Kalubhar Reef Using Satellite Data of 2001



(Source: SAC, 2003b)

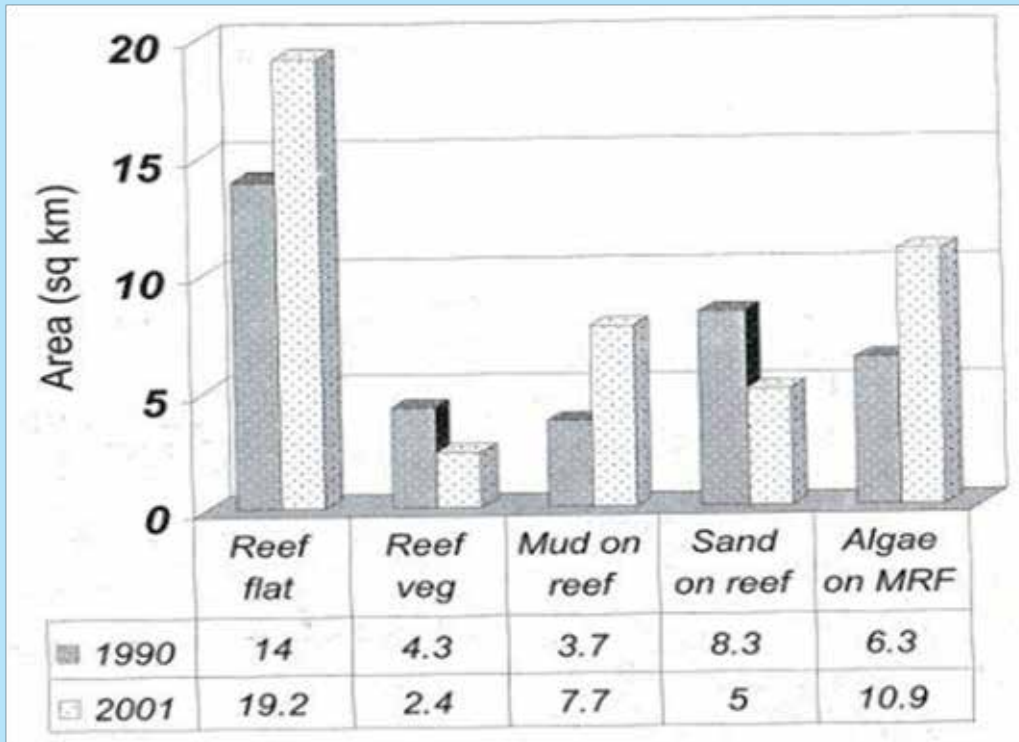
muddy supporting dense mangrove vegetation. Bhaider also has a sandy beach at its western end. This island is relatively remote and therefore so far has not been impacted by anthropogenic pressures. The reef has not undergone major changes between 1990 and 2001 (SAC, 2003b). The area of various ecomorphological zones mapped on the reef for the two periods is shown in Figure. 30.

The difference in the area of reef flat for the two periods is attributed to differing tidal conditions of the two periods during which corresponding satellite images were acquired (SAC, 2003b). Majority of the reef area is occupied by corals, algae and seagrasses (Figure 31). However, a

veneer of mud is also visible, primarily at the middle-eastern edge, and at the lower- western portion (Figure 31).

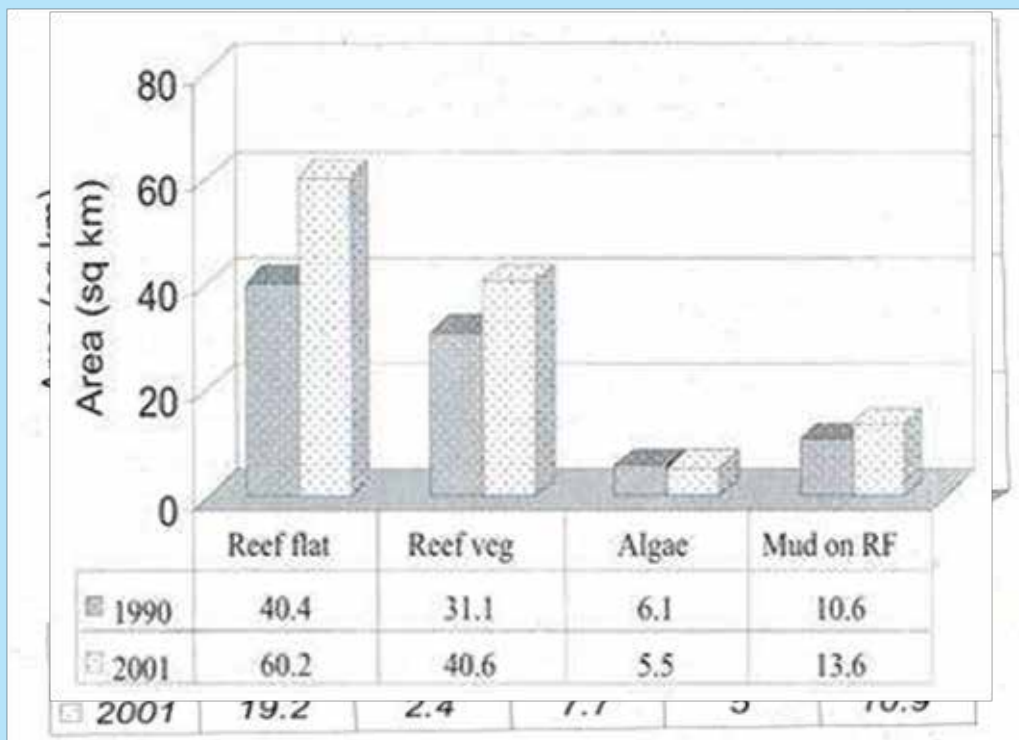
The core area of MNP comprising islands such as Pirotan, Jindra-Chhad and Mundeka-Dideka were mapped and monitored further from 2006 to 2011 by Kumar et al (2013). Among the various reefs mentioned for core MNP, the reef around Jindra-Chhad was observed to be in most degraded condition (Figure 32) (Kumar et al., 2013). The entire reef around Jindra-Chhad was reported to be under sediments on which algal growth was profuse (Kumar et al., 2013). The reef around Mundeka-Dideka bets was also experiencing sediment pressure with much of

Figure 28
Area Occupied by Different Categories of Kalubhar Reef in 1990 and 2001



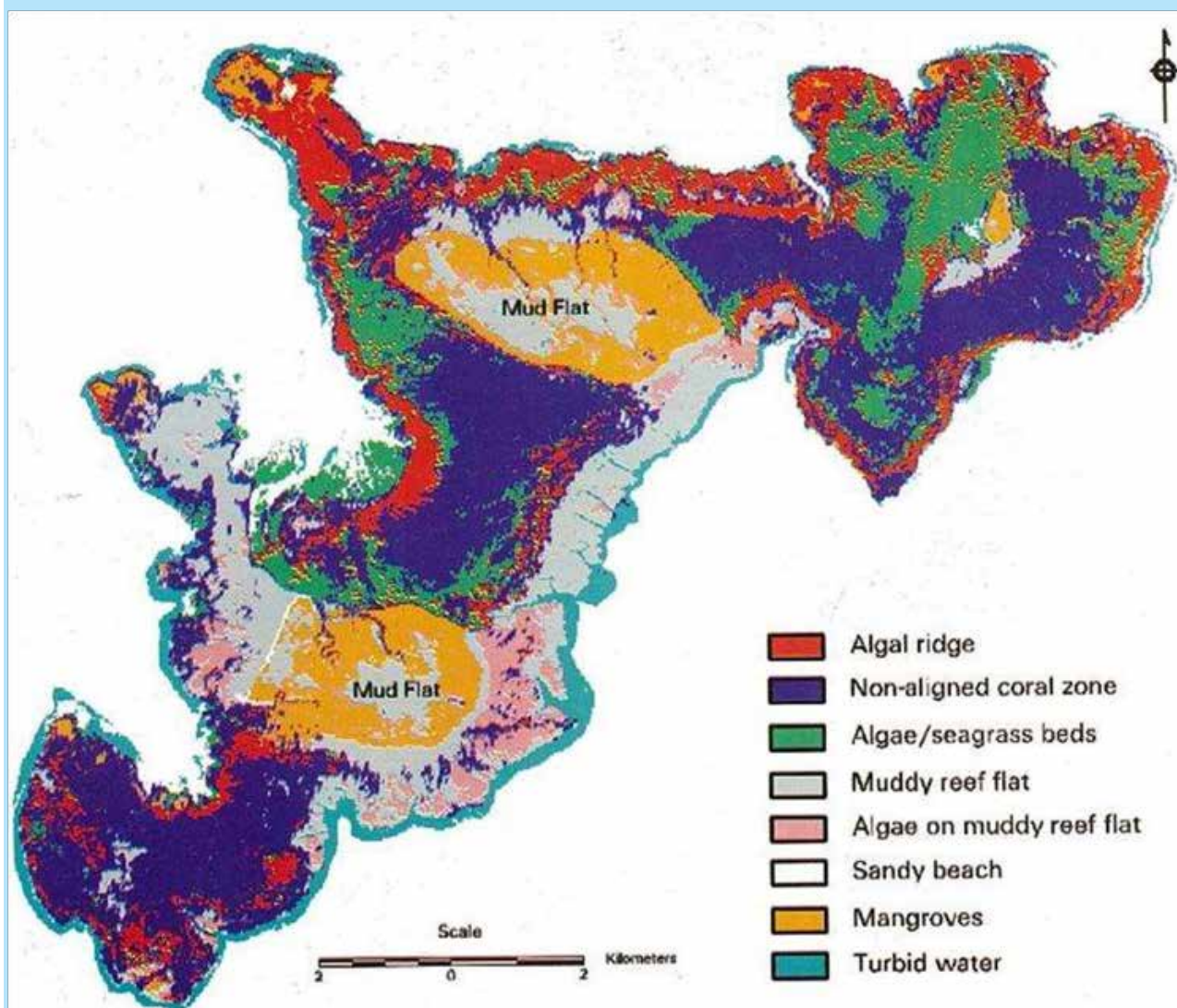
Source: SAC, 2003b

Figure 29
Area occupied by Different Categories of Bural Chank Reef in 1990 and 2001



Source: SAC, 2003b

Figure 30
Ecomorphological Map of Bural Chank Reef Using Satellite Data of 2001



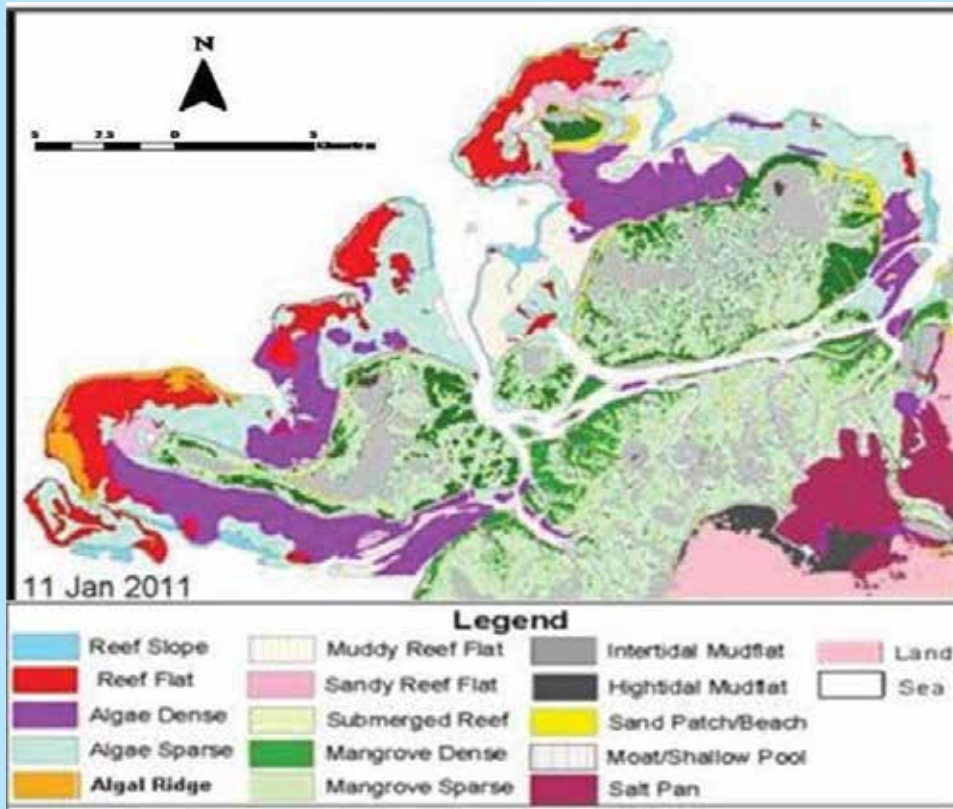
Source: SAC, 2003b

south-western part of reef under sediments. These sediments are frequently colonized by matty algae (Figure 32) such as *Ulva*. Live corals are restricted to the edge of the reef which is exposed to strong tidal currents which probably prevents accumulation of sediments resulting in significant coral growth.

SAC (2012) mapped the coral reefs of the country using satellite data at 1:25000 scale. For Jamnagar, they calculated the reef area to be 352.52 sq. km using the satellite data of 2004-

07 period. Gujarat Ecology Commission (GEC), in collaboration with Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG), mapped the coral formations of entire Gujarat using satellite data of 2010 (in some cases satellite data of 2006 was also used). The area of coral reefs situated along Jamnagar coast, calculated by them comes out to be 413.02 sq. km. We mapped the coral reefs along the Jamnagar coast using Landsat 8 OLI data of 2014 and found the total area of reefs as 443.49 sq. km.

Figure 31
Coastal Habitat Map of Core MNP, Jamnagar for 2011



(Source: Kumar et al., 2013)

Figure 32
Coral Reef Map of MNP, Jamnagar for 2014



Table 27
Area of Different Reefs of Gulf of Kachchh in 2014

Name of the Reef	Area (in sq. km)
Kalubhar	67.84
Gandhiya Kado	16.72
Panero	16.51
Ajad	11.19
Pashu	0.97
Vuda Kuda	4.69
Bural Chank	107.28
Dhani	32.45
Goos	8.32
Pirotan	14.11
Jindra-Chhad	18.87
Mundeka-Dideka	37.67
Sri	0.35
Narara	57.85
Sikka	18.16
Sikotari Tadhora	0.65
Balachadi Raval Pir	9.92
Mungra	1.82
Balachadi Rocks	6.64
Paga	11.48
Total	443.49

Conclusion

The present chapter deals with ecological status of MNP&S. The various events leading to declaration of this area as Protected Area (PA) and subsequent changes have been compiled from secondary and primary data sources and analysed. The entire area is extremely rich in terms of biological wealth with a variety of habitats such as mangroves, coral reefs, seagrasses, mudflats, designing the intertidal landscape. The chapter provides an overview of changes that had happened in the MNP&S, primarily with respect to mangroves and coral reefs – the two important ecosystems of the area.

The entire gulf had very dense mangrove forests prior to 1950 (Nayak and Bahuguna, 2001). Often the plants reached the height of 14 m (Shah et al., 2005) indicating favourable conditions available

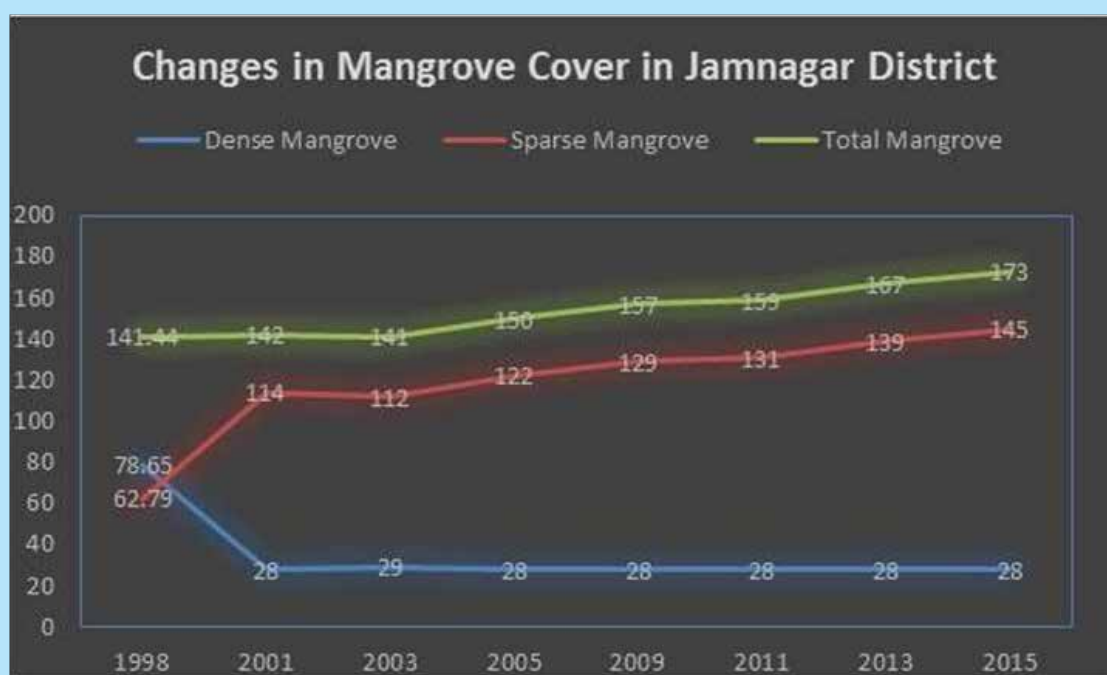
to them for growth. The species diversity was high represented by *Avicennia*, *Bruguiera*, *Cerriops*, *Rhizophora*, *Aegiceras* and *Sonneratia* sp. (Shah et al., 2002). Mostly, the plants were exploited for fire wood and fodder collection. Today, however, *Bruguiera* sp. is extinct from this region, *Rhizophora*, *Cerriops* and *Sonneratia* have become vulnerable and *Aegiceras* has been classified as endangered (Nayak and Bahuguna, 2001). Mangroves were significantly impacted by drought of 1973-76 and 1986-88 periods during which the entire southern coast was ruthlessly exploited by local villagers for food, firewood and fodder purposes. Mangrove area decreased from 138.5 sq. km in 1975 to approx. 47 sq. km in 1988 between Vadinar and Rozi along the Jamnagar coast (Table 21). The annual rate of decrease in mangrove cover between 1975 and 1988 was calculated to be 5.04% (Nayak et al., 1989).

Table 28
Change in Mangrove Area between Vadinar and Rozi in MNP&S

Year	Area (sq. km)
1975	138.50
1982	50.00
1985	33.40
1988	47.65

(Source: Nayak et al., 1989)

Figure 33
Changes in Mangrove Cover in Jamnagar as per FSI



Singh (2000) estimated the mangroves in Jamnagar for 1998 as 141.44 sq. km. This includes 58.21 sq. km of mangrove cover on various islands. The core MNP around Pirotan experienced negative impacts of recurring oil spill incidences. Mangroves at the southern end of Pirotan Island experienced mortality due to oil deposition in 1990-91 (Singh, 2000). Again, oil spill incidence took place on this island in 1993 resulting in death of mangroves in 2-3 ha area (Singh, 2000). The mangroves around Jindra Island suffered severe degradation due to recurring oil spill incidences in 1999 (Figure 22). An estimated 14.7 sq. km of mangrove cover in south-east of Jindra bet was considerably

impacted (Nayak and Bahuguna, 2001; Shah et al., 2005). Mangrove cover increased substantially when observed in 2006 (Kumar et al., 2013). The increase was more in case of sparse mangroves (7.05 sq. km) than in case of dense mangroves (1.97 sq. km) (Kumar et al., 2013). Mundeka-Dideka islands showed consistent development in terms of mangrove cover between 2001 and 2009 (Figure 23). The area impacted by oil spill (southeast of Jindra bet) was observed under sparse mangrove cover in 2006 (Kumar et al., 2013). SAC (2012) mapped the mangrove communities of entire nation and calculated the mangrove cover in Jamnagar as 149.62 sq. km using satellite data of 2005-07 period. Mangrove

Figure 34
Changes in the Reef Area from 1972 to 2014



area mapped by Forest Survey of India (FSI) for Jamnagar district for different years from 2005 to 2015 showed consistent increase in mangrove cover. This progressive increase is attributed to mangrove plantation initiatives carried out by MNP authorities every year.

The coral reefs of MNP&S dotting the southern flank of GoK have been classified into fringing, platform, patch and pinnacles. The coral diversity in this region is relatively low among Indian reefs as indicated by 56 coral species including 44 species of hard corals. However, this area is home to some of the rare coral species such as *Ikedella misakiensis* and *Ikedosoma pirotanensis*. The latter species, in particular, is endemic to this region. The reefs were severely exploited when mining of reefs was initiated in 1930. Mining was later prohibited when the area was declared protected in 1980. SAC has been involved in assessing the conditions of the reefs in GoK using satellite images since 1975. The reef area mapped for 1975, 1985 and 1986 were 217.2 sq. km, 179.7 sq. km and 123.2 sq. km respectively. The reef area declined by approx. 94 sq. km during 1975 and 1986. Mud over reef

area increased from 97 sq. km in 1975 to 257 sq. km in 1986. However, some improvement was noticed in 1990 when the reef area mapped increased by approx. 23 sq. km. The area of various categories of reefs mapped for 1988-90 are given in Table 6. In 2001, an increase of around 3.9 sq. km of reef flat was noticed on Pirotan island (SAC, 2003b), however, in 2006 the area occupied by sediments increased by 2.84 sq. km and consequently the reef flat area declined (Kumar et al., 2013). Sediments have occupied most of the eastern section of the reef on which algal growth was observed in 2006 and 2011 (Kumar et al., 2013). SAC (2012) mapped the coral reefs of the country using satellite data at 1:25000 scale. For Jamnagar, they calculated the reef area to be 352.52 sq. km using the satellite data of 2004-07 period. Gujarat Ecology Commission (GEC), in collaboration with Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG), mapped the coral formations of entire Gujarat using satellite data of 2010 (in some cases satellite data of 2006 was also used). The area of coral reefs situated along Jamnagar coast, calculated by them comes out to be 413.02 sq. km. We mapped the coral reefs

Figure 35
Bleaching in a Coral Colony at Narara Reef



along the Jamnagar coast using Landsat 8 OLI data of 2014 and found the total area of reefs as 443.49 sq. km.

In 2014, some of the coral colonies on this island were found bleached (Adhavan et al., 2014b). Increase in SST due to delay in onset of southwest monsoon and sedimentation were suggested to be the probable reasons for bleaching of coral colonies (Adhavan et al., 2014b). Bleaching was also observed in some coral colonies of Narara reef when the team of researchers from IRADe visited the island in 2015.

Sedimentation was also reported to be one of the major causes responsible for degrading condition of Kalubhar reef (SAC, 2003b). This reef was also observed to be under heavy anthropogenic pressures as evidenced by construction of jetties, pipeline and oil terminals (SAC, 2003b). In comparison, Bural Chank reef was observed to be in better condition as this reef is situated relatively far from the coast.

Overall, it has been observed that declaration of the southern coast of GoK as MNP&S has helped in conservation of the biodiversity of this area. However, intense anthropogenic development

coupled with coastal processes chiefly sediment deposition seems to impact the life in this zone adversely. Though, there have been sporadic efforts of mangrove plantation and coral transplantation in this region, an integrated approach focused on overall improvement of biodiversity in this zone is lacking. Corals also seem to grow on artificial substrata in this region (Dave and Kamboj, 2012) which should be considered encouraging for carrying out transplantation activities in areas where the coral cover has been substantially depleted. The mangrove cover, though, has increased over the years, the diversity is still less. Most of the plantation activities were concentrated on raising *Avicennia*. It is suggested that other mangrove genera such as *Rhizophora*, *Ceriops*, *Kandelia*, *Sonneratia*, *Bruguiera*, and *Lumnitzera* should also be planted on mudflats of MNP&S. This will also help in sequestering carbon from the atmosphere more efficiently. Similarly, it is also required that a variety of coral species be transplanted in the region which will lead to increase in the fish catch of the species. To reduce the sediment pressure on coral reefs, mangroves may be planted at the regions of northern coast of GoK where huge mudflats are lying barren.

Table 29
Socio-economic Details of the Villages Selected for the Perception Survey

Village Name	Total House Hold	Total Population			Occupation wise Households						
		Male	Female	Total	Agriculture	Animal Husbandry	Fishing	Salt Pans	Agriculture and Animal Husbandry	Misc.	Other Works
Sachana	602	2292	2266	4558	107	12	405	0	0	68	10
Sikka	150	626	424	1050	0	0	150	0	0	0	0
Jodiya	600	1147	1053	2200	0	0	350	0	0	232	18
Salaya	600	1900	2100	4000	0	0	600	0	0	0	0
Arambada	750	2241	2259	4500	64	15	358	63	8	148	94
Bet Dwarka	407	1609	1338	2947	0	0	407	0	0	0	0

Source: Marine National Park , Jamnagar, 2015

Chapter 1

Primary Survey: Perception of Fisher Folk Towards MNP and S

Primary Survey: Perception of Fisher folk towards MNP and S

Perception survey was conducted to investigate fishermen's opinions and their acceptance of Marine Protected Areas in vicinity to Marine National Park (MNP), Jamnagar. Survey aimed to determine if the presence of well managed MNP has any positive effect on the adjacent fishing community. The past, current and future perceptions of fishermen towards the status of the fish stocks, the adjacent coral reefs and mangrove and their attitudes towards marine reserves are compared between communities in six coastal villages selected for survey.

Survey provides vital information necessary for the efficient maintenance and future establishment of management policies in Gujarat and other developing coastal states by assessing and understanding the attitude and perceptions of local communities to marine conservation. This will, in turn, emphasize the importance of acquiring strong support from local stakeholders in the maintenance and establishment of reserves, particularly in coastal areas rich in biodiversity.

Study Site

Coastline of Jamnagar and Dev Bhumi Dwarka districts in southern Gulf of Kachchh, Gujarat comprises/consist of 110 villages out of which around 56 coastal villages have been selected under Integrated Coastal Zone Management (ICZM) Project. Based on the provided Socio-Economic information of ICZM project, the survey was carried out in six villages of Sachana, Jodhiya, Sikka, Salaya, Arambada and Bet Dwarka along the coast in the vicinity of Marine National Park. Village Selection was based on the occupational structure, i.e. villages with good fishing population were selected. Socio-economic details of the selected villages along with occupation wise involvement are given in table 5.

Surveys were carried out by the survey team comprising of IRADe team, a translator, fishing community head at village level and some people (social scientists) from Marine National Park, Jamnagar. Fishermen were chosen randomly at all the six sites along the coast and on landing centers; questionnaires had to be carried out

Figure 36
Various Study Sites



Source: Prepared by IRADe

opportunistically as fishermen could only be contacted during the low tide time, which was largely dependent on the weather and sea conditions. In Jodiya, the surveys were mostly conducted around fishermen’s houses (known by the social scientists). Most surveys took 15–20 min, depending on how much information the fishermen’s gave.

Sometimes fishermen were approached as a group, where questions were asked to the fishermen on a one by one basis and the responses were marked in each questionnaire. Fishermen were all artisanal and often fished in crews, for example, in Okha and Sachana, one fisher owned 3-4 boats used by other fishermen in the crew. A total of 35 fishermen were surveyed in Sachana, Jodiya, Salaya, Okha and Arambhada taluka whereas 24 fishermen were surveyed in Sikka. Interviews were also carried out with citizens at city level in Jamnagar city to understand level of awareness about Marine National Park at city level; with the village chief (with a translator); Forest Guards and

project scientist and with others stakeholders. Responses of other stakeholders were recorded in a log book during each interview.

Questionnaire Design

Questionnaires were prepared to investigate the opinions of fishermen towards various aspects of Marine National Park and assess their support for MNP and its conservation. The questionnaires were divided into two sections: Section (A) in which general information including personal questions about the fishermen (such as their age, fishing methods, species frequently caught, etc.) were noted and Section (B) was regarding fishermen’s opinions about the effects of Marine National Park, post its establishment and their willingness to be involved in the management process. In section B, most of the questions were constructed using a Likert-

scale answering system (ranging from ‘Strongly Disagree’ to ‘Strongly Agree’). Other questions had categorical answers, such as ‘Yes’ or ‘No’. Responses from Section A of the questionnaires

were tabulated to show the mean and standard deviation of continuous data and the frequencies of occurrence (in percentage) of categorical data. Data from Section B of the questionnaires were also tabulated to show the percentage of responses to each question from each study area. Categorical responses were presented as 'Yes', 'No' and 'Maybe', where 'Maybe' and 'don't know' responses were combined. Ordinal responses were measured on a five-point Likert-scale (ranging from 'Strongly agree' to 'Strongly disagree') and then reduced to a three-point Likert scale (due to the small sample sizes), containing only the responses 'Agree', 'Neutral' (neither agree nor disagree) and 'Disagree'. The Likert-scale responses were also presented as percentages of each response from fishers at each study site.

Data analysis and Results

Respondent's characteristics:

Table 30 shows a summary of responses to the questions used to gather fishermen's background information. The mean age of respondent was 43.5 years from all the surveyed area. The mean age of fishermen surveyed was greater at the Bet Dwarka site (48 years) compared to other sites of Sikka (46.21 years), Salaya (43.6 years), Jodiya (41.69 years), Arambada (40.69 years) and Sachana (39 years). The mean year of experience was 23 years (in Sachana), 39.7 years (in Salaya), 26.49 years (in Jodiya), 49.83 years (in Sikka), 23.80 years (in Arambada) and 33.4 years (in Bet Dwarka). The fishing gear operated by fishers varied from one site to another; fixed bag net, boat seine, hooks & lines are the commonly used fishing gears in all the sites whereas in Salaya survey showed that most of the fishermen use Trawl longlines (45.71 %) for fishing. There was more overlap between the species caught by fishermen, as prawns, pomfret, blue fish and crabs were caught at all the study sites.

The majority of fishermen surveyed at all the study sites did not have any other source of income or occupation. 2.86 % of the surveyed fishermen in Salaya, Sachana and Bet Dwarka informed that apart from fishing activity they did

have other sources of income. In all the study sites mean boat length was 26 mt in Sachana, 36.46 mt in Arambada, 35.09 mt in Salaya, 25.77 mt in Jodiya, 31.42 mt in Sikka and 38.6 mt in Bet Dwarka respectively. Mean boat power was found to be much higher in Salaya (84.86 HP), Sikka (94.75 HP), Bet Dwarka (61.3 HP) and Arambadha (54.03 HP) in comparison to Sachana (39 HP) and Jodiya (17.10 HP). The mean distance travelled to reach fishing grounds by fishermen was 79.7 km in Salaya, 56.88 km in Sikka, 46.81 km in Jodiya, 42.44 km in Bet Dwarka, 39.16 km in Arambada and 36.23 km in Sachana.

Table 31 shows a greater percentage of fishermen (98.10 mean percentages of all the study sites) answered positively to the question 'Is establishment of Marine National Park/ Marine Protected Area a good thing?' with 100 percent positive responses in Salaya and Sikka. Reasons behind the negative response towards Marine National Park varied from area to area.

The fishermen at Jodiya (5.71 %) were not happy with mangrove plantation activities. They complained that mangrove roots trap sediments which lead to blocking of creeks due to which fishes could not come deep within the creek and the fishermen have to venture out in open ocean for fishing. Fishermen's complaints on sedimentation due to mangroves was not targeted against MNP rather they suggested that concerned regulatory body should work on removing excessive sedimentation that is blocking the creeks.

Table 32 shows that there were significant differences between fishermen responses from each study site concerning increased fish numbers or increased number of species due to establishment of MNP. Most fishermen from all the study sites agreed with the fact that establishment of MNP has increased the number of fish catch (68% in Arambada, 83% in Sachana, 79% in Sikka, 77% in Jodiya, 63% in Salaya and 63 % in Bet Dwarka). However, respondent said that they have experienced significant increase in type of fish species in their catch (80% in

Table 30
Perception Survey Findings

Characteristics	Sachana (n = 35)		Salaya (n = 20)		Jodhiya (n = 35)		Sikka (n = 24)		Bet Dwarks (n = 35)		Arambada (n = 20)	
	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)
Socio-economic characteristics												
Age (year)	39 (14.82)	–	3.6 (10.23)	–	.69 (13.08)	–	6.21 (9.09)	–	48 (8.86)	–	0.69 (9.67)	–
Experience fishing (year)	23 (14.13)	–	9.7 (18.05)	–	.49 (12.81)	–	.83 (21.59)	–	33.4 (14.5)	–	3.80 (7.12)	–
Any other occupation	–	2.86	–	2.86	–	0	–	0	–	2.86	–	0
Fishing characteristics												
Boat length (m)	26 (4.02)	–	5.09 (8.19)	–	5.77 (3.40)	–	1.42 (4.05)	–	38.6 (19.6)	–	.46 (12.72)	–
Boat power (HP)	39 (28.71)	–	.86 (21.29)	–	.90 (14.41)	–	4.75 (7.30)	–	61.3 (50.7)	–	.03 (42.66)	–
Fishing methods												
Fixed bag net	–	65.71	–	68.57	–	82.86	–	–	–	42.86	–	25.71
Boat Seine	–	31.43	–	11.43	–	62.86	–	–	–	–	–	–
Drift net	–	–	–	8.57	–	–	–	–	–	–	–	–
Gillnet (large)	–	–	–	–	–	71.43	–	100	–	57.14	–	68.57
Gillnet (small)	–	–	–	68.57	–	31.43	–	–	–	–	–	8.57
Hooks and line	–	–	–	11.43	–	5.71	–	70.83	–	34.29	–	5.71
ring seines	–	–	–	–	–	–	–	–	–	–	–	–
Traps	–	25.71	–	–	–	11.43	–	–	–	–	–	–
Trawl long-lines	–	–	–	45.71	–	–	–	8.33	–	–	–	–
scoop net	–	–	–	–	–	–	–	–	–	–	–	–
Other	–	–	–	–	–	–	–	–	–	–	–	–
Species present in catcha												
Prawns	–	14.29	–	97.14	–	45.71	–	41.67	–	77.14	–	82.86
Shrimps	–	–	–	–	–	–	–	–	–	–	–	60
Promphet	–	94.29	–	97.14	–	91.43	–	50	–	–	–	42.86
Crab	–	–	–	11.43	–	85.71	–	37.5	–	57.14	–	17.14
Blue fish (surmai)	–	48.57	–	25.71	–	14.29	–	33.33	–	45.71	–	51.43
Lobster	–	–	–	8.57	–	80	–	–	–	42.86	–	25.71
dara fish (Thread fin)	–	42.86	–	–	–	–	–	–	–	5.71	–	25.71
Dutia	–	5.71	–	–	–	8.57	–	–	–	–	–	8.57
Bombay duck (bumbla)	–	–	–	–	–	–	–	8.33	–	20	–	40

Table 30 (Cntd...)
Perception Survey Findings

Characteristics	Sachana (n = 35)		Salaya (n = 20)		Jodhiya (n = 35)		Sikka (n = 24)		Bet Dwarks (n = 35)		Arambada (n = 20)	
	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)	Mean (Std. Dev.)	Freq. of Occur. (%)
Palli (Other Clupeids)	-	-	-	-	-	-	-	-	-	14.29	-	8.57
Kuth	-	8.57	-	14.29	-	-	-	-	-	-	-	-
Sak	-	-	-	-	-	-	-	-	-	8.57	-	-
Cat fish	-	-	-	-	-	-	-	-	-	48.57	-	-
Gold	-	40	-	-	-	17.14	-	8.33	-	22.86	-	11.43
Tuna	-	-	-	-	-	-	-	-	-	5.71	-	-
Garra	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-
Fishing operation												
Distance from coast (km)	.23 (13.54)	-	9.7 (46.65)	-	.81 (33.35)	-	.88 (14.43)	-	.44 (33.07)	-	.16 (32.60)	-
Times per week	4.11 (1.12)	-	4.26 (0.98)	-	4.77 (1.73)	-	4.33 (0.82)	-	4.8 (1.18)	-	4 (1.16)	-
*Note: Freq. of Occur. = Frequencies of occurrence												

Source: Marine National Park, Jamnagar, 2015

Arambada, 60% in Sachana, 75% in Sikka, 83% in Jodiya and 60% in Salaya). Only in Bet Dwarka, 49% fishermen responded that they have not found any different type of fish species in their catch because their fishing operations are not active near or around MNP area, rather they go into deep sea way far from MNP area for fishing.

There were significant differences between areas surveyed in perceptions towards Mangroves, coral reefs and seagrasses, in terms of whether they are important for fishing. Most fishermen felt Mangroves, coral reefs and seagrasses are important for fishing (91% in Salaya, 100% in Sikka, 100% in Salaya, 100% in Arambada and 89% in Bet Dwarka), illustrating how important they considered them for fish growth in the coastal areas.

Fishermen's opinions about their relations with Forest Department were recorded positive in all the surveyed areas. A small fraction of fishermen surveyed (6% in Sachana and 6% in Bet Dwarka)

showed conflict with the Forest Department due to mismanagement in monitoring activities of MNP and other issues like the type of fishing gear operated by neighbouring villages, patrolling activities done by Indian Coast Guards near the coast in Bet Dwarka, etc.

There was a significant difference in the responses received from fishermen of different areas surveyed regarding the issues of conflicts between industries present along the coast in southern Gulf of Kachchh and fishermen. Fishermen's opinion about their relation with industries in all

the surveyed areas were negative because of pollution generated by industries during production process or due to direct dumping into the sea which is causing reduction in their fish catch around the coast. According to them industrial growth is good for some people but it should not violate the environmental norms by creating pollution. 86% of fishermen

Table 31
Fishermen' Opinions about MNP&S

% response to the questions asked	Bet Dwarka		Salaya		Jodhiya		Sikka		Sachana		Arambadha	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Are you aware about Marine National Park	69	31	49	51	74	26	71	29	54	46	71	29
Is Marine National Park a good thing?	100	0	100	0	94	6	100	0	97	3	100	0

surveyed in Salaya and 92% in Sikka, said that due to establishment of industries along the coast condition of fishes and marine life has deteriorated over the period of time in terms of their catch size, fish size and weight, etc. However, in Bet Dwarka and Arambada only 23% and 34% of fishermen surveyed responded negatively towards establishment of industries as they have adapted with the conditions. According to them large industry like TATA Chemicals Ltd is running in that location for last 60-70 years and people living in the vicinity of that area know that fishermen will rarely found fishes in the sea within 1-2 kilometer of area around that industry.

Table 33 shows the fishermen's opinion about the state of fisheries in and around MNP. Comparative opinions were gathered from all the study sites, stating changes in the last 5 years as compared to 10-15 years, which was noticed by the fishermen. Most fishers from all study sites had noticed a difference in the state of marine resources in last 10-15 years. The most common response was 'Yes' to a perceived change in the number of fishermen, most fished species present in their catch (91% in Bet Dwarka, 97% in Salaya, 86% in Jodhiya, 100% in Sikka, 71% in Sachana, 83 in Arambadha), the sizes of the most targeted species (86% in Bet Dwarka, 97% in Salaya, 77% in Jodhiya, 100% in Sikka, 77% in Sachana, 83% in Arambada) and the number of different species caught (91% in Arambada, 80% in Bet Dwarka, 83% in Salaya, 77% in Jodhiya, 88% in Sikka, 71% in Sachana). All fishermen who

noticed a difference in the state of resources felt that resources were better 10-15 years ago and had only noticed negative changes. Reasons may vary from area to area like in Sachana where most of the respondents blamed industrial pollution as the major threat to fishes in and around their fishing area and also use of small nets by big trawlers from Salaya village behind decrease in fish number and size (See Table 33 given below).

Most fishermen in all the study sites stated that they were asked to change their fishing methods and gears (63% in Bet Dwarka, 86% in Salaya, 77% in Jodiya, 100 % in Sikka, 86% in Arambada and 89% in Sachana), as shown in Table 34. According to fishermen, assigned personnel from Department of Fisheries have prohibited them to use small nets for fishing because small sized nets capture too many small fishes that are not big enough to eat and catch is also wasteful because these small fishes will not have the opportunity to grow into a size that would provide a "good meal" as well as good economic cost to the fishermen. Though 86% of fishermen surveyed in Salaya said that they have been asked to stop the use of small nets for fishing but most of the fishermen are still using small nets for fishing. During the survey it was observed that neighbouring villages like Sachana and Jodiya also responded negatively against Salaya village on using small nets for fishing and raised complaints to ban such activities forever.

Most fishermen at all the sites did not know of any Marine National Park Management Plan (89% in

Table 32
Descriptive Statistics on Survey Statements Designed to Quantify Fishermen’s Opinions
about Marine National Park (MNP)

% Response to the statements	Bet Dwarka			Salaya			Jodhiya			Sikka			Sachana			Arambadha		
	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A
MNP increased the number of fish catch	31	6	63	37	0	63	17	6	77	17	4	79	14	3	83	0	9	68
MNP increased the type of fish catch	23	28	49	23	17	60	11	6	83	21	4	75	11	29	60	9	11	80
Mangrove, reef, seagrass, etc. are important for successful fishing	0	11	89	0	0	100	6	17	77	0	0	100	0	9	91	0	0	100
MNP has raised conflict between fisherman & Forest Dept.	77	17	6	100	0	0	94	6	0	100	0	0	94	0	6	100	0	0
Conflict between fishermen and industry	63	14	23	14	0	86	63	3	34	8	0	92	57	9	34	49	17	34

*Note: Statements were measured in a five-point Likert-scale and subsequently dropped to a three-point Likert- scale: Disagree (D), Neutral / Neither agree nor disagree (N) and Agree (A).

Table 33
Fishermen’s Opinions or Perception about the State of Resources

% response in	Bet Dwarka		Salaya		Jodhiya		Sikka		Sachana		Arambadha	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
In the last 5 years, compared to 10- 15 years ago, I’ve noticed a difference in the												
Number of (most fished species) in the catch	91	9	97	3	86	29	100	0	71	29	83	17
Size of (most fished species) in the catch	86	14	97	3	77	23	100	0	77	23	83	17
number of different species present in the catch	80	20	83	17	77	23	88	12	71	29	91	9

Table 34
Fishermen's Opinions about MPA Management

% response in	Bet Dwarka		Salaya		Jodhiya		Sikka		Sachana		Arambadha	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
MPA's Management												
Ever been asked to start/stop the use of any kind of fishing gear	63	37	86	14	77	23	100	0	89	11	86	14
Involvement in planning of MNP												
Do you know about any management/conservation plan	6	94	11	89	0	100	0	100	0	100	3	97
Would you like to be involved in management/conservation of MNP?	94	6	100	0	94	6	100	0	100	0	100	0

Bet Dwarka, 89% Salaya, 97% in Arambada and 100% in Sikka, Jodiya and Sachana claimed they did not know), however, 94% in Bet Dwarka, 94% in Jodiya, 100% in Arambada, Salaya, Sikka and Sachana show more of an interest and are keener to be involved in planning procedures of conservation or management plan for Marine National Park. Fishing community presidents at all the study sites, positively responded and said that they are ready to support government for any kind of conservation activity but being one of the key stakeholder, fishermen and fishing community should be involved or consulted before preparation of management or conservation plan towards conservation of marine area.

Results and Discussions:

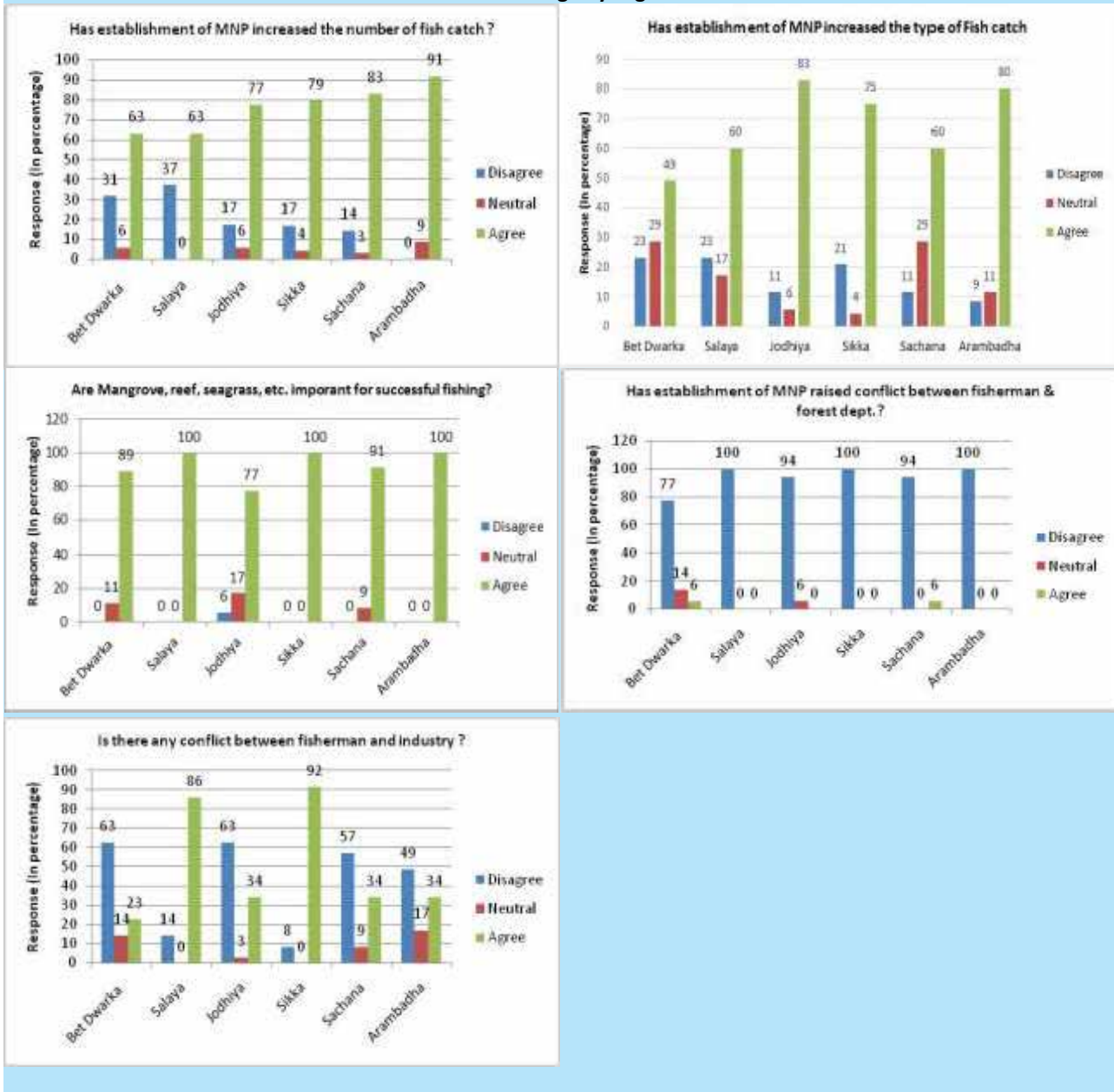
The hypotheses investigated in survey concerned Fishermen's acceptance and perceptions towards establishment of MNP based on responses received from fishermen at six sites along the coast. Results showed differences in fishermen's attitudes towards MNP and factors that did or did not influence their opinions. The small sample sizes of fishermen at each study site (Sachana=35, Jodiya=35, Sikka=24, Salaya=35, Arambada=35 and Bet Dwarka=35) are limitations to the findings of this study. However, this study does provide a useful insight into the trends of fishermen's perceptions and acceptance towards Marine Protected Areas like MNP at all survey sites and may act as a pilot

study that could aid in the design of a more comprehensive study in the future. Any future studies should aim to collect data from a larger sample size of fishers in order to have confidence in any statistical outputs during data analysis.

All the survey sites were concerned with Marine National Park management to conserve coral reef areas and mangroves. While, on an overall basis, the total fish catch has shown increasing trend over the years, but there is a drop/decline observed in total catch in recent years. Similarly, while the total fish catch data recorded an increasing trend, discussion with the fishermen revealed a sharp decline in 'catch per unit effort' in recent years. This mainly owes to overall environmental degradation of fishing areas due to rapid industrial development and construction of breakwaters for ports and jetties, Single Point Mooring (SPM) stations, etc.

The planning, implementation and management of any Marine Protected Area are all dependent on human aspects and stakeholders' perception towards conservation. Participation of fishermen is crucial for implementing management or conservation plans, which is often difficult to implement due to fishermen having different opinions towards management (Dimech et al., 2009). There is a need to give adequate attention to social challenges of Marine National Park (such as gaining acceptance of those dependent on resources in that area). The high level of

Figure 37
Timeline Showing Key Legislations



acceptance towards MNP and its conservation and community based management is important for effective management with local involvement for optimal success and acceptance of MNP. Notion behind conserving ecology of marine area may become ineffective if a regulator doesn't have lower levels of support from fishermen's and other related stakeholders. Field observations states that fishermen with little or no knowledge about MNP are ready to support and keen to become part of planning and management so that conservation of MNP

can be done without affecting their fishing activities. Results from field survey also interpret that a higher proportion (an average of 98.10% from all survey sites) of respondents felt Marine Protected Area or Marine National Park as a good thing for marine ecosystem and their livelihood (which is likely due to the fishermen's having already seen benefits of the MNP reflected in their catches since the MNP was implemented in Jamnagar) and they would like to be involved in management or conservation planning of Marine National Park.

Conclusion

Similarities and differences were found between fishermen's responses from each study site. The high levels of acceptance towards MNP or MPAs found in this study were encouraging at all the study sites. Evidence of support for MNP or MPAs from fishermen's were found during the survey from all the study sites, which shows that fishermen's with little or no knowledge of Marine National Park or MPAs can still support them as a conservation management strategy (even if they feel their fishing activity will not be affected). Although fishermen's had mixed views towards some aspects of Marine National Park (such as causing conflict), the general impression was that fishermen's had accepted it and perceived the benefits they had received from it in the past, however any issues that fishermen's felt had arisen due to industrial pollution, use of illegal fishing gears, etc. should not be ignored. Community-based management of MNP or MPAs was favoured at all the six study sites; effective management by regulatory bodies with local involvement is important in and around MNP for optimal success of MNP, and community-based management may be the method favoured by small, artisanal fishing communities in other areas.

The positive opinions towards awareness campaigns were also received from fishermen in the entire study areas. Fishermen's groups during focused group discussions suggested that there is a need for more awareness campaigns amongst fishing villages so that wrong methods of fishing can be stopped to increase the fish production (size and catch) in and around MNP.

As seen in this study, fishermen's perceptions of Marine National park or MPAs are subject to change depending on their previous experiences;

therefore, work of this sort is an ongoing process that should be carried out throughout their existence to gauge the support they receive from local communities. Future work could include studies with larger sample sizes, to investigate opinions of fishermen's living in the vicinity of Marine Protected Areas not only in Gujarat but also in other states of India where Marine National Parks exists.

Governance and Policy Review

India has no specific legislation for Marine Protected Areas. The protected areas are declared under the provisions of the Wildlife Protection Act, 1972 (amended in 2002 and 2006) in both terrestrial and marine ecosystems. Under the provisions of this act, a core area of 162.89 sq. km was declared Marine National Park and 457.92 sq. km as Marine Sanctuary in 1982.

History of Legislations

The timeline of key legislations governing the MNP&S can be seen in Figure 34. Initially, two acts namely Wildlife Protection Act and Environmental Protection Act were passed by the Government of India which focused on designating and declaring protected areas. Thereafter under these acts, guidelines and regulations were brought out to regulate commercial activities to protect and safeguard the forests and wildlife of India. The features of these regulatory legislations are explained in subsequent section.

The coastal governance in India has diverse institutional arrangements for decision-making for development and ensuring safeguards for the environment which occur at three levels of government: national, state, and local. These legislations are implemented by the Ministry of Environment and Forests (MoEF) at national level

Chapter 7

Governance and Policy Review

and through the designated State Departments of Forests and Environment at state level. Table 21 shows the agencies/ departments responsible to implement the provisions of various acts.

Marine Parks are designated for conservation and preservation of the ecosystems such as coral reefs and mangroves. In the case of fisheries management, there is a central legislation relating to maritime jurisdiction, demarcation of the Exclusive Economic Zone (EEZ), regulation of fishing by foreign vessels, and management of fisheries.

Regulatory Legislations

Coastal Zone Regulations, 1991 (amended 2011)

In 1991, MoEF issued a notification under Section 3 of the Environment Protection Act of 1986, to regulate development activity on India's coastline. The approach adopted by the first notification was to define the 'High Tide Line' (HTL) and 'Coastal Regulation Zone' (CRZ) and thereafter specify the activities permitted and restricted in the vicinity of the CRZ.

Table 22 shows that the regulated zone is divided as per the land use into four categories and the activities that are permitted in them:

The 1991 Notification failed to acknowledge the diversity of Indian Coastline and stipulated uniform guidelines for the entire coastline including Andaman & Nicobar Islands and Lakshadweep. There have been about 25 amendments to this notification between 1991 and 2009, following criticism on lack of proper procedure and time bound clearances, rigid enforcement measures and failure in protecting the interests of traditional coastal communities. Therefore, to address these issues, Ministry brought out Coastal Regulation Zone Notification, 2011.

CRZ classification was retained as per 1991 Notification, only change being addition of water area upto 12 nautical miles towards seaward side. This was done to control the discharge of untreated sewage, effluents and disposal of solid waste to protect marine life. However, no restrictions are being imposed on fishing and allied activities of the traditional fishing

Figure 38
Timeline Showing Key Legislations

Acts/ Legislations	Enforcing Agency / Implementing Agency		
	National	State (Gujarat)	Local
<ul style="list-style-type: none"> Indian Wildlife Protection Act, 1972 Environment Protection Act, 1986 CRZ Notification, 2011 EIA Notification, 2006 	<ul style="list-style-type: none"> Ministry of Environment & Forests (MoEF) 	<ul style="list-style-type: none"> Forest & Environment Department State Designated Agency for Impact Assessment 	<ul style="list-style-type: none"> MNP & S
<ul style="list-style-type: none"> Water (Prevention and control of pollution), Act 1974 Hazardous Waste Management Act, 1989 	<ul style="list-style-type: none"> Central Pollution Control Board (CPCB) 	<ul style="list-style-type: none"> Gujarat Pollution Control board (GPCB) 	<ul style="list-style-type: none"> Urban Local Body (ULB)
<ul style="list-style-type: none"> Disaster Management Act, 2005 	<ul style="list-style-type: none"> National Disaster Management Authority (NDMA) 	<ul style="list-style-type: none"> Gujarat State Disaster Management Authority (GSDMA) 	<ul style="list-style-type: none"> District Emergency Control Unit

communities.

As per the provisions of this notification, all coastal states are required to ensure the following:

1. Phasing out existing practice of discharging untreated waste and effluents (within two years) and dumping of solid waste (within one year from the commencement of the Notification).
2. Preparing an Action and Management Plan for dealing with pollution in coastal areas and waters and in a time bound manner.

For the state of Gujarat, the draft Integrated Coastal Zone Management Plan (ICMZ) has been prepared and Government of Gujarat has appointed a State level committee to review and finalize it. This State Project Management Unit (SPMU) includes representatives from State departments of Forest, Irrigation, Fisheries, Tourism, Gujarat Maritime Board, Gujarat Pollution Control Board (GPCB), Gujarat Ecology Commission (GEC), GEER Foundation and BISAG.

This notification has laid down the process for obtaining CRZ clearance from the State/ UT Coastal Zone Management Authority. It has also laid down the method and time frame in which actions to be taken in case of any violation. To ensure the transparency in the working, the CZMA has to create a website and post the agendas, minutes, decision taken, clearance letters, violations, action taken, court cases etc. Gujarat CZMA has a functional and updated website.

Environmental Impact Assessment Notification, 1994 (amended 2006)

Environmental Impact Assessment (EIA) is an important planning and management tool for ensuring optimal use of natural resources for sustainable development. The purpose is to identify and evaluate the potential impacts (beneficial and adverse) of development and projects on the environmental system. This exercise should be undertaken early enough in the planning stage of projects for selection

Table 39
Classification of Coastal Regulation Zones

PARAMETERS	CRZ I	CRZ II	CRZ III	CRZ IV
LAND USE	Ecologically sensitive areas such as mangroves, coral reefs, salt marshes, turtle nesting ground and the inter-tidal zone.	Areas developed close to the shoreline and falling within municipal limits.	Coastal areas that are not substantially built up, including rural coastal areas.	Water area upto 12 nautical miles from ITL towards seaward side and tidal influenced water bodies.
ACTIVITIES PERMITTED	<ul style="list-style-type: none"> * No new construction except projects relating to the Department of Atomic Energy; Pipelines, conveying systems including transmission lines; * Between ITL and HTL in areas which are not ecologically sensitive, the following may be permitted; Exploration and extraction of natural gas; Construction of social infrastructure after obtaining approval from concerned CZMA. 	<ul style="list-style-type: none"> * Buildings are permissible on the landward side of the existing road, authorized structure or hazardous line where there are no authorized structures. * Desalination plants and storage of non-hazardous cargo 	<ul style="list-style-type: none"> * Between 0-200 meters from HTL is a No Development Zone except projects of Dept. of Atomic Energy/ Forestry/ Agriculture. * Between 200-500 meters of HTL, construction and repair of houses of local communities, tourism projects etc. 	<ul style="list-style-type: none"> * No restriction on the traditional fishing and allied activities. * No untreated sewage, effluents or solid waste shall be dumped in these areas.

of environmentally compatible sites, process technologies and such other environmental safeguards.

EIA has now been made mandatory under the Environmental Protection Act, 1986 for 29 categories of developmental activities involving investments of Rs. 50 Cr. and above. The project proponent has to conduct EIA studies and prepare an Environmental Management Plan (EMP) which is required for formulation, implementation and monitoring of environmental protection measures during and after commissioning of projects.

For coastal zones, States are required to prepare ICZM plan, identifying and categorizing the coastal areas for different activities and submit it to the MoEF for approval. They are required to carry out studies on carrying capacity of natural resources of these coastal areas.

Guidelines for declaring Eco-Sensitive Areas around National Parks and Sanctuaries, 2011

In 2011, MoEF issued guidelines to create eco-sensitive zones (ESZs) around Protected Areas to prevent ecological damage caused due to developmental activities around National Parks and Wildlife Sanctuaries. These areas act as “shock absorbers” to the protected areas by regulating and managing the activities around such areas. As per the procedure, State Governments have to submit proposals to declare ESZ around national parks and develop management plan for the same. Thereafter, state forest department have to group broad thematic activities under the following three heads:

- Prohibited,
- Restricted with safeguards and
- Permissible

After reviewing and accepting the proposal from Gujarat Government, in 2013 MoEF issued a notification declaring the total area of 326.26 sq. km around Marine National Park and Marine Sanctuary as Eco-Sensitive Zone (ESZ). Notification states that the area upto one km from the coastal boundary towards landward side; an area within 200 m from the boundary of MNP & S towards seaward side and 31 rivers

Table 40
Categorization of Activities at MNP&S

Prohibited	Regulated	Permitted
Commercial Mining	Felling of trees	Ongoing agriculture and horticulture practices
Setting of saw mills	Establishment of hotels/ resorts	Rain water harvesting
Setting up of industries	Drastic change of agriculture systems	Organic Farming
Commercial use of firewood	Commercial use of natural water resources	Use of renewable energy sources
Establishment of major hydroelectric projects	Erection of electric cables	Adoption of green technology for all activities
Use of Production of any hazardous substances	Fencing of premises of hotels	
Undertaking activities like flying over MNP by aircraft/hot air balloons	Use of polythene bags by shopkeepers	
Discharge of effluents and solid waste in natural water bodies or terrestrial area	Widening of roads	
	Movement of vehicular traffic at night	
	Introduction of exotic species	
	Protection of hill slopes and river banks	
	Air and vehicular pollution	
	Sign boards and hoardings	

flowing into the Gulf of Kachchh with their length varying from 0 to 5 km and a width of 250 m from the centre of the river, on both sides of river from the MNP & S boundary comes under ESZ.

Following the standards, ESZ covers an area of 208.58 sq. km towards landward side, 105.14 sq. km towards sea and 12.5384 sq. km covered by rivers along with MNP & MS which covers an area of 162.89 sq. km and 457.92 sq. km respectively and the entire southern Coast of the Gulf in Jamnagar district is ringed by a cluster of 42 islands and many of them are fringed by coral reefs and mangrove vegetation.

States are required to prepare a Zonal Master Plan that shall provide for restoration, conservation and management of the sensitive ecosystem while protecting the needs of local communities. As mentioned earlier, Gujarat Government is in process to finalize the ICMZ.

Policy Analysis

Coastal areas in India today face multiple

environmental issues due to overexploitation of the natural resource base, conflicting uses among various stakeholders in addition to the natural and man-made disasters. Environment Policies and Regulations in India, attempt to address coastal issues through the use of coastal zoning in order to spatially separate incompatible uses and protect fragile environment / ecosystems. Table 24 summarizes the various legislations and area covered by them in and around MNP & S.

Figure 35 shows the location of industries along the coast of Gujarat. To study the impact of these industries and provisions of these legislations on our study area, an HTL is mapped along the coast of our study area. Thereafter, buffer zone of 100, 200, 500 and 1000 meters are demarcated to identify the influenced areas (Figure 36 and 37). This was done to map and analyse the land use based on the activities in the eco sensitive zone.

From the above Figures, the following observations are made:

Figure 41
Location of Industries along Gujarat Coast



- There are oil and cement industries within 200 m of HTL which as per CRZ Notification is No Development Zone.
- Major small and big industries lie within 500 metres of HTL. However, between 200-500 metres of HTL, only traditional coastal communities are allowed to build their houses and carry out activities for their livelihood.
- The details related to disposal of waste from the industries lying in Eco sensitive zone (within 1 km of MNP & S) are ambiguous.

Management of Marine National Park

After the enactment of MNP&S (1980 and 1982 respectively) a number of significant changes have taken place. Among them, is the increase in number of industries in the vicinity of the Marine Protected Area (MPA). The area has seen setting-up of some of the mega industrial projects after 1982, which has subsequently transformed the area between Sikka to Narara into an industrial zone. The pollution caused by industries and development activities has been posing threat

to the marine biodiversity. Apart from this, the Marine Protected Area is challenged by multiple issues of illiteracy of local people, their large scale dependence on GoK for livelihood, and untreated disposal of waste and sewage by the neighbouring cities and towns. The involvement of multiple government departments over the protected area, and limited fund allocation by the state as well as central governments are further adding to the problems of the management authorities. Despite all these challenges, the survival of the MPA over the years has been possible only due to the consistent efforts put in by the Forest Department and MPA authorities. At present, MNP circle is headed by Conservator of forests, Jamnagar, assisted by a Deputy Conservator of Forests and Assistant Conservator of Forests followed by Range Forests Officers. The area is divided into six territorial ranges viz. Dwarka, Bhatiya, Khambhaliya, Sikka, Jamnagar and Jodiya for protection purposes. Also there is one Cher range, which is overlapping range designated mainly for looking after the activities of plantation, interpretation, development of

Table 42
Various Legislations Governing MNP & S

CRZ Notification, 1991	CRZ Notification, 2011	EIA Notification, 1994, 2006	MoEF Guidelines on ESZs, 2011	Gujarat Govt. Notification on ESZs, 2013
<ul style="list-style-type: none"> Coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in the landward side) upto 500 metres from the High Tide Line (HTL) Land area between HTL & LTL 	<ul style="list-style-type: none"> Land area from HTL to 500mts on the landward side along the sea front. Land area between HTL & LTL the water and the bed area between the LTL to the territorial water limit (12 NM) 	<p>Any project or activity located in whole or in part within 10 km from the boundary of</p> <ul style="list-style-type: none"> Protected Areas, Notified Critically Polluted areas Notified Eco-sensitive areas 	<ul style="list-style-type: none"> Defining the extent of eco sensitive zones around protected areas kept flexible and the width and type of regulation will be area specific. As a general principle, land falling within 10 km of the boundaries of national park and sanctuaries. 	<ul style="list-style-type: none"> 1 km. distance from coastal boundary towards landward side 250 m from the centre of the river to both sides (31 rivers flowing through) 200m from MNP & S boundary towards seaward side

Figure 43
Eco Sensitive CRZ in and around Vadinar



Figure 44
Co Sensitive CRZ in and around Sikka



museum and tourism. In addition to this, there exists one survey range working under the direct supervision of Conservator of Forests for survey and demarcation works of the MNP.

Management Plans

MPA was managed on the basis of annual action plans from 1982 to 1991; the first management plan was prepared for the ten-year period (1991-2001). This plan was approved by the Chief Conservator of Forests (Wildlife) and Secretary to Forest and Environment Department, Gandhinagar. It was the first management plan of its kind for a Marine Park in India. Thereafter, Dr. H.S Singh (Conservator of Forests, Jamnagar) prepared a new management plan in May 1994 providing more details about the resources and management practices based on zone plan. However, this plan was not approved over the existing plan and hence, its relevance remains limited to historical and academic purpose.

After the first management plan expired in 2001-02, the Forest Department formulated annual plans till 2004-05. The latest management plan available is for the period of 2006-07 to 2016-17. The objectives of all the management plans are aimed at protection and habitat improvement of the biota in the area i.e. mangrove forests, coral reefs, wildlife, marine life, and awareness among the public. All the management plans available for the MNP&S were read and reviewed. The summary of the same are as follows:

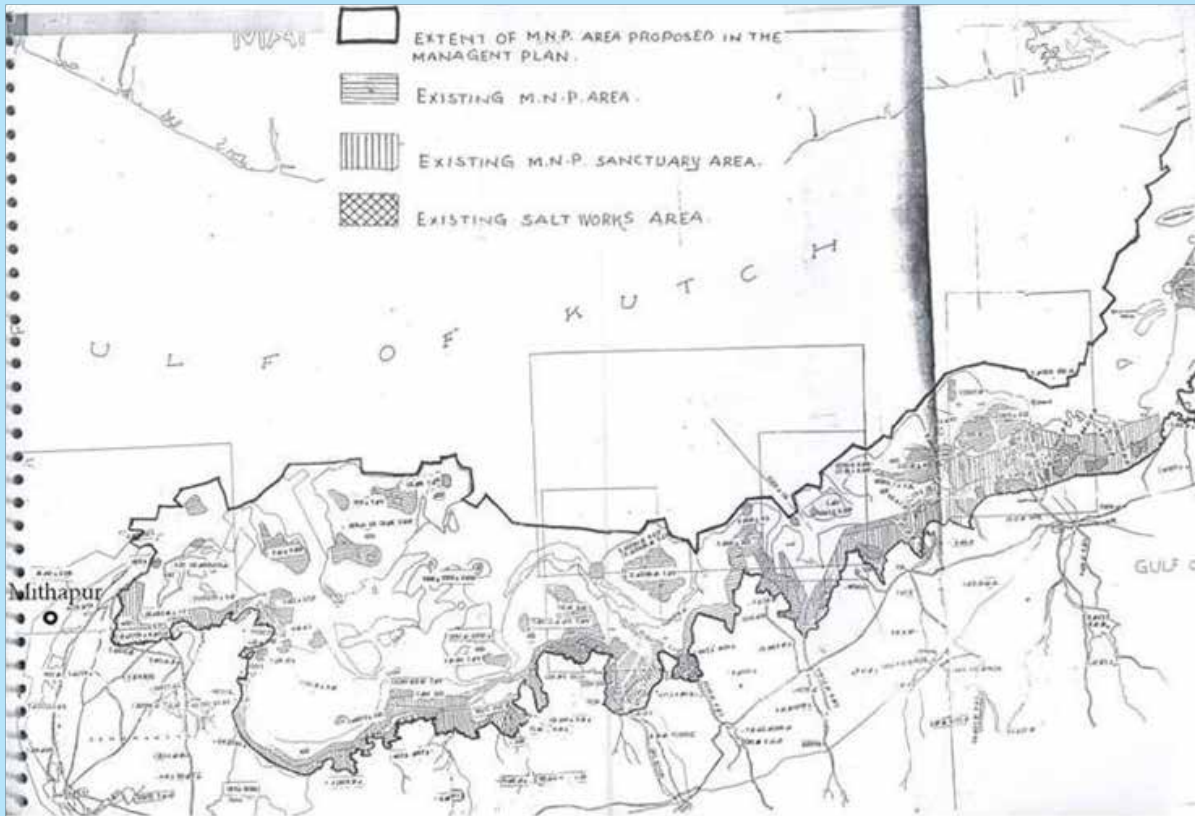
Management Plan (1991-2001)

The first management plan was an ambitious plan which talked about filling gaps in terms of infrastructure and human resources in the Forest Department. But as listed in the successive management plans (2006-07 to 2016-17), most of the proposals were not implemented. The Table 28 below gives details of the plan's proposals and their status:

Table 39
Details of the Management Plan 1991-2001 Propositions and Their Status

Human Resources	Status
Proposed posts (no's) for forest department: Dy. Conservator of Forests (2) Assistant Conservator of Forests (6) Coastal range forest officers (10) Dy. Coastal rangers (26) Coastal beat guards (76) Orderlies guard (18) Armed constTable (4) Jeep driver (8)	<ul style="list-style-type: none"> • Only 1 post of Dy. Conservator of Forests was filled under the Integrated Forestry Development Programme (IFDP) Scheme. None of the others were sanctioned. • This has been a major drawback as efficient management is not possible without adequate technical staff.
Training for staff in the field of marine biology	<ul style="list-style-type: none"> • Proposed training for staff in the field of marine biology and coral reef management was not carried out. • Timely training is necessary for capacity building of the staff.
Infrastructure	Status
Proposed no's in terms of vehicles/equipment: Jeep (10) Boats (11) Small Boat (1) Boats for tourism (2) Boats for transport (2) Fast Port Boat (2)	<ul style="list-style-type: none"> • Only 1 jeep and 4 boats were purchased during the plan period.
Proposed purchase of weapons: Service revolver of point 38 calibre (10) 303 riffle (13) Total cost of rupees 10.02 Lacs	<ul style="list-style-type: none"> • No weapons were purchased during the plan period and even the sanction for a service weapon was not accorded, • The weapons are very useful for range forest officer and field staff for discharge of their duties.
Construction of 3 jetties on the islands (Azad, Bhaidar and Kalubhar) were proposed at the total cost of Rs. 33 Lacs	<ul style="list-style-type: none"> • The jetties were not constructed during the plan period. • Later, the tender for construction of one jetty at Pirotan Island was given to Gujarat Maritime Board. This was not completed and the Government incurred futile expenditures. • The incomplete pillar at Pirotan is proving to be an obstruction for the boats approaching Pirotan.
Boundary Demarcation: <ul style="list-style-type: none"> • Southern side of MNP&S is bounded by revenue area of Jamnagar and Rajkot while north side has Gulf of Kachchh. Coastline from Pindara Bay ascends in form of a hypotenuse that meets the north eastern side. • The areas in the initial notification didn't have special boundary demarcation except at a few places, the plan proposed new Park and Sanctuary. While on southern side, a new boundary was prescribed as per the revenue boundary, northern or seaward side boundary would be upto 5.5 fathom depth. 	<ul style="list-style-type: none"> • The boundary demarcation work for the MPA was carried out partially. Most of the demarcation was completed in the landward side. However, the proposed demarcation towards seaward side (by fixing marking buoy) was not implemented. • One of the drawbacks of the proposed boundary demarcation (on land) was not including the Mithapur area, having rich coral reefs (it has been represented in the Figure 41).
Mangrove Plantation and Treatment of blank mudflats	Status
<ul style="list-style-type: none"> • Approx. 210 sq. km of area on and near the southern seas coast (GoK) and islands have depleted and degraded forests. Approx. 2100 ha of mangrove plantation was proposed every year. • Silviculture operation was supposed to be carried out on the mudflats having negligible or nil growth, and with potential of supporting Cher Forests. • Target was set at approx. 2000 ha per year for 3-5 years. 	<ul style="list-style-type: none"> • Proposed mangrove plantations and treatment (restoration) of blank mudflat was not fully implemented. • More than 11000 ha of plantations were carried out during the plan period. Mangrove plantation was done mainly by polypots and direct sowing method, having very little success.

Figure 45
Boundary Demarcation of MNP&S in the Management Plan (1991-2001) around Sikka



Important work undertaken under the plan (1991-2001):

Despite the shortcomings, some important decisions were taken under the first management plan are mentioned below:

i. Renewal of Calcareous sea sand leases from the park and sanctuary:

Collection of sand and corals were permitted from certain areas in the MPA. The lease was given to M/S. Digvijay Cement Co. Ltd., Sikka for collecting corals and sand from the MNP area. This lease was later cancelled and the company was persuaded to change their wet processing cement plant (used corals as a raw material) to a dry processing unit. The alternate lease for collecting limestone was given to the company in nearby forest area in Jamnagar district.

ii. Check on illicit cutting of mangroves:

Stringent measures were taken to keep check on illicit cutting of mangroves for fuel wood

and fodder. The grazing by camels was also brought under control. Vagher communities (Fisherman communities and professional woodcutters) were persuaded and made aware by the forest department for the protection of mangrove forests.

iii. Propagation of Migratory Sea Turtles:

The nests of migratory turtles (which come for laying eggs at Saurashtra coast) are destroyed by scavengers and sometimes taken by humans. For the protection of sea turtles, a programme for their artificial breeding in hatchery was carried out at various places. The eggs were collected from their nests and brought to the hatchery, and after successful hatching the young ones were released into the sea. From 1985 to 1989, a total of 1, 53,731 number of eggs were collected and 1, 11,490 number of turtle hatchlings were hatched and released

into the sea. The total expenditure incurred on this account till March 1989 was Rs. 1, 88,267.

iv. **Nature Education Camp:**

Camp was conducted in different islands from 1982 till March 1989. More than 115 such camps were conducted at a cost of Rupees 2, 51, 995 and 8317 individuals were benefitted.

Reasons behind less achievements and ineffective implementation:

As stated in the Management plan (2004-05), the major problems that came in the way of implementation of first management plan were:

- i. Multiple involvement of various Government Departments (Forest Department, Gujarat Maritime Board, MNP Authorities etc.) in the Marine Protected Area.
- ii. Even after the declaration of MPA, a number of industries (both private and government) came up in vicinity of the protected area; high dependence of the local fisherman for their livelihood resulting in adverse effect on marine biodiversity.
- iii. Shortage of field staff, absence of vessels/ vehicles and equipment needed by the Forest Department. The boats that were available with the Forest Department were old and in bad condition.
- iv. Unavailability of sufficient funds with the Forest Department

Annual Action Plans from 2001-02 till 2004-05

The first management plan expired in 2000-01. From 2001 to 2004-05, annual action plans were implemented. Details of the important work done under these action plans are as follows:

i. **Afforestation Programme:**

Large scale compensatory afforestation programme was undertaken. Regularization of the salt leases (issued to 16 salt works in Jamnagar district in the past) were done under the Forest Conservation Act. Plantation of more than 12000 ha of land was

carried out as a compensatory afforestation programme, and mangroves were planted under the Centrally Sponsored Scheme. A total of 1500 ha area was planted during the implementation of plan period.

ii. **Bio-physical Monitoring:**

Introduction of bio-physical monitoring of coral reefs was done for the first time. Scientists from Zoological Survey of India, Chennai and marine biologist from GEER Foundation, Gandhinagar were assigned the job of training the young staff of Forest Department. The trained staff carried out the bio-physical monitoring work at Pirotan, Narara, Kalubhar and Poshitra Island. A report was also published discussing the results of the entire exercise.

iii. **Marine museum**

Marine Museum that was already present in Jamnagar was upgraded under the Integrated Forestry Development Programme (IFDP) scheme and an aquarium was also constructed. Both the aquarium and museum attracts a good number of tourists in Jamnagar.

Management Plan (2006-07 to 2016-17)

The latest management plan available for the MNP &S is the second management plan i.e. for 2006-07 to 2016-17. The plan is focused on various important aspects for the conservation of the MPA. Some of the important aspects are:

- i. As per this plan, the Forest Department/ MNP authority are still experiencing severe shortage in terms of staff (protection staff, drivers, clerks, boat's khalasis, marine biologists, researchers etc.) and infrastructure (boats and necessary weapons/ equipment). In such circumstances, it is difficult for the management authorities to deliver the desired output and work for the conservation of the protected area. To deal with this, this plan proposed a total of 58 new posts under 18 different categories at the total cost of Rs. 165.72 lacs. Also, a fund of Rs. 50.34 lacs were proposed for purchasing the vehicle,

equipment and hiring of boats etc.

During the first management plan, the boundary demarcation work only on the landward side was completed. Therefore, a survey and demarcation program was proposed again under this plan, where a fund of 117.50 lacs was earmarked.

ii. The plan also proposed to classify the protected area into different zones as given below:

1. **Core Zone:** The Pirotan island and the cluster of islands located around Poshitra and other area exclusively covered by coral reefs are included in this zone.
2. **Intensive Management Zone:** Entire Marine Protected area i.e. Marine Sanctuary (457.90 km²), Marine National Park (162.89 km²) and Cher forest (917.16 km²) comes under this zone.
3. **Tourism zone:** Narara and Pirotan islands
4. **Ecodevelopment Zone:** 58 villages located on the southern coast of Gulf of Kachchh

The first management plan also proposed the zoning of MPA into two zones. Zone one had areas of Vadinar, Bedi, Navlakhi and Jodiya and zone two had Okha, Poshitra, Bhatiya and Salaya. However, there is no clarity over the implementation of the zones. Apart from this, the zones proposed by this plan were overlapping in terms of boundaries indicating no clear purpose of zonal classification.

iii. In order to improve the socio-economic conditions of the local people, the management plan proposed eco-development plan. With a total assigned budget of Rs. 306.51 lacs, the plan includes developing water supply pipelines, reclamation and maintenance of bunds in agricultural lands for preventing the salt ingress, construction of check dams, and construction of soak pits for latrines

and disposal of sewage water in villages, construction of community latrines, construction of ponds for water conservation etc. A scheme for collection of plastic and its disposal (25 lacs) was also planned under the eco development plan; where the local people were only supposed to collect the plastic waste and the forest department has to buy back these wastes for circulation and reuse. This initiative can be helpful in reducing the plastic pollution in the region and providing a livelihood option for the locals.

- iv. As a part of the plan, the Zoological survey of India (ZSI) have transplanted corals from Mannar to Gulf of Kachchh on three occasions; first on December 12, 2013; four months later on April 27 and then on September 13. As of now, ZSI has been successful in regenerating the 'branching corals' from the southern tip of Gulf of Mannar to Gulf of Kachchh in Gujarat. ZSI had identified Pirotan, Narara, Poshitra and Mithapur islands for the purpose of transplantation project. ZSI would take the next step after monitoring the sustained progress of the project over the next few years. This is a commendable success achieved by the MNP authorities. Earlier, the transplantation of coral was supposed to be carried out on selected locations like Goose reef and Pirotan Island. The parent material was planned to be brought from Andaman and Nicobar Island and Lakshadweep Island.
- v. The plan proposed to extend the Marine Sanctuary area to 503.05 km². There are certain areas in Gulf of Kachchh which has diverse coral reefs and other marine fauna, but are not covered under the previously declared MNP &S. Hence, it was proposed to include the following areas as a part of Marine Sanctuary:
 1. Coral reefs of Huda Kuda reef near Chank reef in Dwarka taluka,

2. Coral reefs near Balachadi in Jamnagar taluka and
3. Mungra reef in Jodiya taluka.

An area of 12 ha near Mithapur and 14.50 ha near Shivrajpur in Arabian Sea have diversity in terms of corals. Since, the corals are now covered under the Schedule-I of the Wildlife Protection Act, the species get protection through legislation. However, the habitat is not automatically protected and therefore it is proposed to bring these areas under the Wildlife Protection Act and cover under Marine Sanctuary. The Mithapur area was not included in the extended boundary of Park and Sanctuary as proposed by first management plan's proposal of protected area boundary extension.

In 1991, the Conservator of Forests, Jamnagar proposed an area of extension into the GoK up to the depth of 5 fathom which will cover all the areas in the GoK having coral reefs. As mentioned above that it is required to protect both the corals and their habitat, it is necessary to extend the boundary of the Marine Sanctuary on seaward side 5 fathom deep as proposed above.

- vi. The plan also emphasized on conservation of endangered species, education and training, and bio-physical monitoring of coral reefs. For this purpose, total allotment of 85.94 lacs, 135.43 lacs and 32.09 lacs were earmarked respectively.

Present Status of the Plan:

The demarcation work proposed by the plan is very important, for the protected area conservation authorities, industries as well as for other stakeholders (local people etc.); this will not only help in proper management of the protected area but will also reduce the conflicts among different stakeholders. But as mentioned above, the boundary demarcation work proposed in the first management plan was not fully implemented and the leftover work (demarcation on seaward side) was passed

to the second management plan (needless to say that action plans also came between the two management plan). As there is very little information available on the progress of the works done under the second management plan not much can be said about the same.

The plans emphasized on awareness programmes and socio-economic development of the area on a sustainable basis. Second plan proposed eco-development projects which is an important step as it would help in reducing the dependence of the local people on the MPA and would diversify their livelihood. However, not much of the information has been available about the work executed on ground level.

As discussed in the first management plan (1991-2001), the protected area authorities are short of staff, necessary equipment/weapons/vehicles and proposed the recruitment/procurement of the same. The second management plan which came almost after 15 years stated that the most of the proposed staff positions/ vehicles/ weapons proposed under the first plan were not sanctioned. In addition to fulfilling previously stated positions, the second management plan talked about hiring marine biologists and research officers along with setting up a fully functional marine research station/laboratory. While talking to the management authorities during the field trip, they stressed on facing budget issues. This has been restricting them in affording the required human resource, infrastructure, and delivering the desired targets proposed in management plans. The State and Central Government need to give a serious thought if they wish to protect the MNP&S.

All the management plans consistently mentioned that the industries in the vicinity of the MPA are posing serious threat to the biodiversity and ecosystems of the region. But, the fact is that the most of the industries have come after the enactment of MNP&S and some even after the arrival of management plans. A few of these industrial activities/developments are as below:

Table 40
Major Industrial Developments in MNP&S

Year	Industrial Development
1984	Completion of Gujarat State Fertilizer & Chemicals Ltd. jetty, beginning of Ship-breaking and recycling at Sachana. GSECL thermal power plant at Sikka Operational
1988	Tata Chemicals Ltd at Mithapur subsea pipeline laid in MNP
1993	GSECL Thermal power plant at Sikka started operating
1997	Operation of Reliance Petroleum Ltd. Refinery at Jamnagar started operating
1998	Expansion of Mundra Port
2002	Gulf of Kachchh granted special status for industrial development
2004	Essar Oil Ltd. Refinery at Vadinar started operating
2009	Commissioning of Adani Thermal Power Plant at Mundra, Bharat Oman Refinery Ltd. Subsea pipeline constructed in Marine National Park
2010	Essar Thermal Power Station at Vadinar started operating
2012	Tata Power Ultra Mega Power Plant at Mundra started operating

The above Table shows that the authorities responsible for giving clearance certificates to the industrial projects were either not aware about the future impacts on the MNP& S or were ready to overlook the existence of the ecosystem and biodiversity in the region for the economic development. Moreover, there has been loose framing (with loopholes) and partial implementation of the policies, regulations and notifications like CRZ-2011, Environment Protection Act, 1986 (as discussed in the sections above). As a result, various polluting industries have been established in an eco-sensitive area. This all had not only increased the threats and pressures on the MPA but also have increased the responsibilities of Forest Department and MNP&S authorities. In such circumstances, the MPA conservation authorities and industries have to work in close coordination following the principle of co-existence of economy and environment. Jamnagar is an economic hotspot with world class refinery and many other industries, it is also blessed with bio diversity hotspot with 3 ecosystems viz; Coral Reefs, Mangroves and Khijadia bird sanctuary. For the successful co-existence of both the hot-spots, we need to

formulate some rules of co-existence and respect each other's existence by developing deeper understanding of what it takes to maintain healthy biodiversity and work our ways around it. This then can be a unique example for many others to follow as this is not the only bio diversity hotspot that is under pressure from economic activities. It is necessary to follow the rules of coexistence. We split the recommendation in several categories:

Management and Coordination

- Management plan of MNP should be actively shared with various stakeholders and developed through involvement of key stakeholders which will help in developing stake and evolve co-operative mechanism for management of Marine National Park. Although the management plans so far have included more or less, all the necessary steps/suggestions/recommendations which are required for the efficient conservation and management of the MNP&S. Still the major problem lies in the implementation of these as many of the proposed plans have

Chapter 8

Way Forward and Recommendations

been passed from one to another.

- The longer periods of management plans make it difficult to track the progress done under a plan period of 10 years. Hence, it is recommended to monitor the activities done under the management plans after short intervals (preferably annually) for which a monitoring committee must be constituted to keep a check on the implementation of proposed work, and should bring interim result reports. In addition to this, a committee comprising representatives from community, experts and prominent stakeholders should be involved for monitoring the management plans. Mechanisms for monitoring of Management Plans for MNP are not set and there is need for strengthening the Management Information Systems for monitoring management plans. Framework for Management Effectiveness Rating of Marine Protected Areas should be developed for Marine Protected Areas.
- Coordination: The contingency and environmental plans followed and framed by the industrial stakeholders must be closely monitored and checked. The role of all the authorities that are managing the protected area (Forest Department, MNP, GMB etc.) should be streamlined in order to avoid coordination issues and improve their accountability for the assigned responsibilities. The role of all the authorities that are presiding over the protected area (MNP, Forest Department, GMB etc.) should be streamlined in order to avoid coordination issues and improve their accountability for the assigned responsibilities.
- Coastal governance mechanisms need to be strengthened through Gujarat State Coastal zone management authorities. Seascape approach should be designed for management of Marine National Park. Blue print for the same should be drawn in collaboration with Gujarat Ecology Commission. Greater interdepartmental co- ordination between the various departments involved in the management

of marine and coastal ecosystems is required for better understanding of the various regulations in place, reducing their complexity and enhancing possibilities of compliance. Multidimensional partnerships with convergence of purpose are needed to overcome barriers and to identify problems. It is important to identify the remedial measures and make deadlines to achieve tangible results. Clear framework should be evolved addressing the roles and responsibility of each stakeholder towards conservation of Marine National Park.

- There is need to setup a coordination mechanism among research groups working in Marine National Park area. Research should be done pursuing the research agenda defined in the management plan of MNP. Industries should encourage research activities and should provide funds for better management and conservation of MNP.

Monitoring, Regulation & Surveillance

- Pollution Monitoring Standards should be set on the basis of carrying capacities, and the standards should get more stringent, to reduce total pollution loads. That is, the standards need to be raised as well as strict monitoring of industries. There should be strict vigilance on coastal and shoreline activities of industries. Comprehensive pollution profiling that simultaneously maps ecosystems, ports and shipping, industries, socio-economic patterns is necessary along with demographic data. The list of pollutants should be monitored and frequency of monitoring should be increased as activities change or increase. If necessary, incentives for industries to adhere to the regulations can be discussed with provision of self-monitoring, subject to periodic checks and penalties.
- Stakeholders consider oil spills as biggest threat to the Marine National Park. Contingency plans for oil spills should be developed in consultation with stakeholders which will outline the roles of key stakeholders in the case of an oil spill. Every stakeholder should be prepared with oil spill contingency plan so that they can come together to control and reduce the damage caused by the oil spill. Such contingency plan will help the stakeholders to be ready and technically prepared enough to immediately respond in case of an oil spill incidence. The cost incurred to clean oil spills and maintain a disaster management cell for spills is very high. Increasing commitments of shipping industries, ports and governance is necessary. They need to share costs and responsibility and methods of sharing costs by polluters need to be devised. Penalties are inadequate, therefore, risk sharing is necessary as damage caused to the environment and ecology remains unaddressed even if penalties are paid. It is necessary to review the industrial policies with regards to oil spill contingency plans. It should be mandatory for all the ports to create Environment Management Plans. Zero effluent discharge technologies must be encouraged.
- Monitoring and surveillance for protection - Base/stations should be established at specified islands such as Pirotan, Kalubar, Bural Chank, etc. for surveillance. Joint surveillance teams with involvement of forest department, navy, coastal guards, local communities need to be established.
- Urban Waste Management: As given in the management plan that on the southern parts of the Jamnagar district (on sea coast areas) the towns like Navlakhi, Jodiya, Balachadi, Sikka, and Salaya are located and the city of Jamnagar and village Bedi are adjacent to Gulf of Kachchh. None of these towns has efficient solid waste management and sewage management system. The management plan mentioned to accomplish the needful. There is scope for improvement of trash and solid waste collection both in residential and industrial areas, like plastic collection scheme proposed under the eco development plan in which the locals can

also be involved for waste collection. The waste water treatment capacity and removal efficiency can be increased and the water can be recycled for useful purposes (if possible for agriculture too).

- Awareness about Eco-sensitive zones with respect to Marine National Park should be circulated to all the stakeholders in local languages is essential and sensitization should be done by all the stakeholders on priority basis through capacity building, awareness campaigns, etc. We need t. It is also essential to encourage stakeholders like school children's and young adults who are not even in touch and aware of this biodiversity and resources around. Ideal way is to provide awareness and inform them about significance of the MNP&S and its biodiversity in the same way we are trying for fishing community.
- Proper planning and regulation of the fishing activities is very important for conservation of Marine National Park. Sustainable Fisheries Management Plan should be developed for the area in consultation with Forest Department and community. Again, monitoring mechanisms should be set to control the incidences of overfishing and illegal fishing in and around the Marine National park islands.
- Most importantly the process of clearance of developmental projects in and around the MPA should be transparent and in line with the necessary conservation policies and regulations. Also, the policies and regulations that are meant for the conservation of the Marine Protected Areas should be revised and amended when required.

Research

- The scientific documentation of the ecology viz. species diversity and density over a period of time since the establishment of MNP is not available. To assess the changes in the status of the ecology and for better management

it is important that such documentation is done on a periodic basis. There is clear need for ensuring that scientific exercises are done for documenting the flora and fauna of Marine National Park. Assessment of the same would help to understand clearly the changes, associated reasons and devising measures for better management of Marine National Park.

- Broad Research agenda should be developed for MNP for short term and long term basis with inputs and involvement of key stakeholders and experts. Impact Assessment studies are required to undertake a comprehensive study on the impact of industrialization on the the MNP. It can ensure the identification of issues and needs for livelihood security of fisher folk. This would help in understanding whether traditional fisheries are better vis-à-vis modern fishing methods. Vulnerability assessment studies should be done for the Gulf of Kutch region and Coastal Resilience Plan should be developed in wake of uncertainties arising due to climate change. Studies should be done to assess the impacts of climate change on the MNP and further mitigation and adaptation strategies should be devised for same. Vulnerability assessment studies should be done for the Gulf of Kutch region and Coastal Resilience Plan should be developed in wake of uncertainties arising due to climate change.
- A Marine Research Station (having marine biologists, Research Officer, a Chemical Analyser and two laboratory assistants) was proposed, but it has not been established yet. The research station is necessary in carrying out the research activities, monitoring the conditions imposed on the different industries operating in the area. Development in research is also needed for carrying out the plantation/ restoration activities using advanced techniques/ methods which should give better results and can avoid mortality of species (as happened in the case of mangrove plantation). So,

establishing the research station should be done on priority basis.

- GIS based mapping provides excellent decision support tool for monitoring of the spatio-temporal changes as well as for effective implementation of management plan of MPAs. Such technologies should be also well used for monitoring of bio-diversity and landuse changes in CRZ and eco-sensitive zone.
- Natural Resource Accounting where depreciation of natural resources is accounted for can serve as a guidepost. What is important is to take proactive action, identifying barriers and remedial measures. This ecological profiling would aid in better management practices and help in observing the changes taking place at any one point of the area for remedial action. Marine wealth has to be recognized and only valuation of ecosystems will help understand levels of degradation. Valuing loss of natural capital is important. Framework for Natural resource accounting for the protected areas needs to be defined.

Community Participation:

- The Forest Department should increase the involvement of local communities and village Panchayats (assign them roles and responsibilities) in the management and conservation of framework of Marine Protected Area. This will also result in decreasing conflicts among the forest department and local people and help in conservation of the area. Effective participation of local communities in management and conservation activities such as mangroves plantation should be ensured, especially in view of the understanding and knowledge that communities have about their ecosystems, and how their economic activities relate to their social environment. Local people should be made aware of mangroves' type, environmental condition required for plantation and

mangroves contribution to the water table in wells. Community participation should not be used as labour rather they should be involved for long term as trained mangrove planters where after plantation they should be capable enough to take care of the mangroves. Ecosystem services derived from the mangroves need to be communicated to the community. Organic farming among the farmers needs to be encouraged to reduce the threat created by fertilizers and pesticides on the regional biodiversity.

- Alternate and sustainable livelihood options for local communities such as seaweed cultivation (involving endogenous species), aquaculture, mariculture and eco-tourism should be further explored in consultation with community should be promoted and supported. Introduction of seaweed species from other countries should not be promoted at the cost of local flora.

Common Vision Statement & Key Roles and Responsibilities of the Stakeholders

Following roles and responsibilities are recommended for better management of MNP:

1. Dept. of Forest and Environment, Govt. of Gujarat

- Preparation & effective implementation of management plans
- Monitoring various (biological and other) parameters
- Effective deployment of new and advanced technologies such as GIS, remote sensing, modelling to monitor the periodic changes in the mangrove and coral reef patterns of MNP
- Involvement of local communities and village Panchayats for conservation and management
- Capacity Building and spreading awareness among local communities

2. Gujarat Maritime Board, Govt. of Gujarat

- Effective operationalization of Vehicle Traffic Management System (VTMS) in Gulf of Kutch.

- Need of development of lighthouses (particularly at Kalubhar and Bural Chank islands) and availability of seas traffic information
- Establishing monitoring stations within MNP to continuously monitor changes in sea traffic.

3. Dept. of Fisheries, Govt. of Gujarat

- Survey & assessment of fish stock
- Charting fish grounds and monitoring of fish catch to control overfishing.
- Fisheries regulation, management and conservation
- Maintaining data & dissemination to other groups
- Development of Fisheries Management Plan for sustainable fish harvest
- Awareness building on sustainable fish catch
- Diversification of livelihood activities eg. aquaculture

4. Gujarat Pollution Control Board

- Effective implementation of Environmental laws to control marine pollution.
- Regular monitoring about generation, treatment and disposal of hazardous and solid waste through different ways
- Review and implementation of international standards for pollution control
- Strict vigilance on coastal and shoreline activities of industries and regular monitoring of the water samples in GoK
- Collection of funds as pollution fines and damage which can be used in long-term Programmes. Settlements may also be reached to mitigate specific pollution caused by oil spills, and special funds allocated advance to finance clean up
- Comprehensive pollution profiling that simultaneously maps ecosystems, ports, shipping industries, socio-economic patterns and demography
- Formulating strategies so that shipping and

other industries should themselves plan to contain their effluents and damages

- Periodic scrutiny of underwater oil pipelines to detect any leakage and must be subjected to independent evaluation by experts.

5. Indian Coast Guard

- Protection of coastal & marine environment from marine accidents such as oil spillage. Patrolling, monitoring and vigilance.
- Developing capacity of various agencies for disaster management and to equip them with the latest knowledge, techniques and technological tools to cope with adverse event, spillage, etc.

6. Gujarat Industrial Development Corporation

- Provide land for waste disposal & CETP plants
- Development of Industrial Park and provide land for industrial development

7. Central Marine Fishery Research Institute

- Estimation of Marine fisheries landing & fishery catchment
- Marine Census
- Marine fish farming
- Formulate Fisheries Management Plan for Marine Protected Areas

8. Marine Bio-resource Centre

- Preparation of digital data bases of Marine Bio-resources of the state
- Initiate Bio-prospecting programs
- Develop a common platform for Linkages within all Stakeholders
- Create awareness about marine biota

9. Central Salt & Marine Chemicals Research Institute

- Efficient utilization of marine biodiversity
- Environmental Monitoring and Research & development on marine Bio-resource
- Conducts survey on seaweed biodiversity

10. Gujarat Ecological Education and Research Foundation

- Initiates and facilitate scientific researches & studies
- Monitoring and evaluation of MNP&S and its biodiversity
- Advocacy for judicious and scientific management of Natural resources.

11. Space Applications Centre

- Thematic area mapping of ecology of MNP&S such as mangrove and coral cover, using GIS & remote sensing
- Spatial & temporal monitoring of MNP

12. Integrated Research and Action for Development

- Policy research and analytical support for management of MNP
- Economic valuation of the Marine National Park

13. Gujarat Ecology Commission

- Support restoration and conservation of all major eco systems and for efficient, effective and integrated management of Gujarat coast through seascape approach
- Awareness about pollution control among all stakeholders and networking them for participatory and proactive action for formulation and conservation.
- Community engagement

14. Zoological Survey of India

- Coral survey and monitoring of the health of the corals in India.

15. Industries

- Best practices documenting for pollution control
- Creation of pool of funds for pollution accidents
- Financial support under CSR for conservation and management
- Provision of regular data on environmental parameter

- Technologies for monitoring of oil spill
- Reuse of treated sewage
- Implementation of zero process effluent discharge system

16. Jamnagar Municipal Corporation

- Investment in STP
- Reuse treated sludge for industrial development
- Spreading awareness among citizens about importance of MNP and its conservation

17. Local Communities

- Appreciating and conserving the biodiversity of MNP&S through sustainable utilization of natural resources
- Promoting the use of traditional knowledge
- Actively participating in the meetings/discussions associated with MNP
- Use of fishing nets of appropriate sizes so that the juveniles are not trapped
- Regulation of fishing activities in breeding season
- Plantation and preservation of mangroves
- Sustainable harvesting of marine produce ensuring least damage to reefs

**Annexure I
Ecological Diversity of MNP**

Ecological Diversity of MNP		
Core Mangrove Species	<i>Avicennia officinalis</i> <i>Avicennia alba</i> <i>Avicennia marin</i> <i>Rhizophora mucronata</i> <i>Ceriops .tagal</i> <i>Acanthus ilicifolius</i> <i>Aegiceras corniculatum</i>	
Mangrove Associates	<i>Suaeda nudiflora</i> <i>Sesuvium portulacastrum</i> <i>Salvadora 114</i> <i>érsica</i> <i>Salicornia brachiata</i> <i>Ipomoeae pes-caprae</i> <i>Arthocnemum indicum</i>	
Algae	<p>Chlorophyceae <i>Ulva beytensis</i> <i>Ulva lactuca</i> <i>Ulva reticulata</i> <i>Ulva compressa</i> <i>Ulva clathrata</i> <i>Ulva flexuosa</i> <i>Ulva intestinalis</i> <i>Ulva linza</i> <i>Ulva prolifera</i> <i>Cladophora glomerata</i> <i>Chaetomorpha spiralis</i> <i>Boodlea composita</i> <i>Stuvea anastomosans</i> <i>Caulerpa microphysa</i> <i>Caulerpa racemosa</i> <i>Caulerpa racemosa var. Occidentalis</i> <i>Caulerpa scalpeliformis var. Denticulata</i> <i>Caulerpa sertularitoides</i> <i>Caulerpa taxifolia</i> <i>Caulerpa veravalensis</i> <i>Codium decorticatum</i> <i>Codium geppiorum</i> <i>Halimeda macroloba</i> <i>Halimeda tuna</i></p> <p>Phaeophyceae <i>Ectocarpus confervoides</i> <i>Ecocarpus siliculosus</i> <i>Giffordia mitchellae</i> <i>Dictyopteris delicatula</i> <i>Dictyota cervicornis</i> <i>Dictyota ciliolata</i> <i>Dictyota dichotoma</i> <i>Padina boergesenii</i> <i>Padina tetrastomatica</i> <i>Spatoglossum asperum</i> <i>Hydroclathrus clathratus</i> <i>Iyengaria stellata</i> <i>Cystoseira indica</i> <i>Sargassum cinctum</i> <i>Sargassum cinreum</i> <i>Sargassum tenerrimum</i></p> <p>Rhodophyceae <i>Scinaia carnosa</i> <i>Scinaia complanata</i> <i>Scinaia hatei</i> <i>Dermonema virens</i> <i>sAhnfeltia plicata</i> <i>Gelidium pusillum</i></p>	

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

<p>Algae</p>	<p><i>Gracilaria corticata</i> <i>Gracilaria follifera</i> <i>Gracilaria salicornia</i> <i>Gracilaria textorii</i> <i>Asparagopsis taxiformis</i> <i>Halymenia porphyraeformis</i> <i>Halymenia venusta</i> <i>Amphiroa anceps</i> <i>Amphiroa fragilissim</i> <i>Hypnea valentiae</i> <i>Sarconema filiforme</i> <i>Solieria robusta</i> <i>Solieria chordalis</i> <i>Champia indica</i> <i>Gastroclonium iyengarii</i> <i>Botryocladia leptopoda</i> <i>Coelarthrum opuntia</i> <i>Gelidiopsis repens</i> <i>Digenea simplex</i> <i>Acanthophora specifera</i> <i>Centroceras clavulatum</i> <i>Ceramium tenerrimum</i> <i>Spyridia filamentosa</i> <i>Wrangelia tanegana</i></p>	
<p>Lichens</p>	<p><i>Arthonia antillarum</i> <i>Arthonia cinnabarina</i> <i>Arthonia medusula</i> <i>Arthonia polymorpha</i> <i>Arthonia radiata</i> <i>Arthonia variata</i> <i>Bactrospora sp.</i> <i>Caloplaca cupulifera</i> <i>Caloplaca squamosa</i> <i>Caloplaca sulipoliotera</i> <i>Cresponia flava</i> <i>Diorygma megasporium</i> <i>Dirina indica</i> <i>Dirinaria confusa</i> <i>Dirinaria consimilis</i> <i>Enterographa pallidella</i> <i>Gleoheppia túrgida</i> <i>Graphis striatula</i> <i>Lecanora achroa</i> <i>Lepraria lobificans</i> <i>Opegrapha albocinerea</i> <i>Opegrapha arabica</i> <i>Opegrapha graphidiza</i> <i>Opegrapha varians</i> <i>Opegrapha vulgata</i> <i>Peltula obscurans</i> <i>Phylliscum indicum</i> <i>Phylliscum testudineum</i> <i>Rocella montagnei</i> <i>Sulcopyrenula staurospora</i></p>	
<p>Hard Corals</p>	<p><i>Acanthastrea hillae</i> <i>Coscinaraea monile</i> <i>Cyphastrea serailia</i> <i>Dendrophyllia minúscula</i> <i>Favia favius</i> <i>Favia speciosa</i> <i>Favites bestae</i> <i>Montipora hispida</i></p>	

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

<p>Hard Corals</p>	<p><i>Montipora monasteriata</i> <i>Montipora turgescens</i> <i>Montipora venosa</i> <i>Mycedium elephantotus</i> <i>Paracyathus stokesi</i> <i>Platygyra sinensis</i> <i>Plesiastrea versipora</i> <i>Polycyathus verrilli</i> <i>Porites compressa</i> <i>Porites lutea</i> <i>Porites lichen</i> <i>Psammocora digitata</i> <i>Pseudosiderastrea tayami</i> <i>Siderastrea savignyana</i> <i>Symphyllia radians</i> <i>Tubastrea aurea</i> <i>Tubastrea faulkneri</i> <i>Turbinaria crater</i> <i>Turbinaria peltata</i></p>	
<p>Soft Corals</p>	<p><i>Astromuricea stellifera</i> <i>Dendronephthya brevirama</i> <i>Dendronephthya dendrophyta</i> <i>Echinogorgia flora</i> <i>Echinomuricea uliginosa</i> <i>Ellisella andamanensis</i> <i>Ellisella maculata</i> <i>Gorgonella rubra</i> <i>Juncella juncea</i> <i>Leptogorgia australiensis</i> <i>Lobophytum pauciflorum</i> <i>Lophogorgia lutkeni</i> <i>Nicella dichotoma</i> <i>Pennatula sp.</i> <i>Plexauroides praelonga</i> <i>Sclerophytum polydactylum</i> <i>Telesto rubra</i> <i>Thesea flava</i> <i>Virgularia rumphii</i></p>	
<p>Seagrasses</p>	<p><i>Halophila beccarii</i> <i>Halodule uninervis</i> <i>Halophila ovalis</i> <i>Halophila ovate</i> <i>Zostria marina</i> <i>Thalassia hemprichii</i></p>	
<p>Sponges</p>	<p><i>Ophlitaspongia sp.</i> <i>Crella cyathophora</i> <i>Grantessa hastifera</i> <i>Leucandra donnani</i> <i>Leucandra wasinensis</i> <i>Sycon grantioides</i> <i>Jaspis stellifera</i> <i>Jaspis reptans</i> <i>Acanthella cavernosa</i> <i>Acanthella klenthra</i> <i>Clathria reinuordti</i> <i>Haliclona fascigera</i> <i>Haliclona cymiformis</i> <i>Cribrochalina obemada</i> <i>Ircinia ramosa</i> <i>Theonella cylindrica</i> <i>Leuconia sp.</i></p>	

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

Sponges

Euplectella sp.
Geodian variospiculosa
Donatia seychellensis
Tuberella aaptos
Chondrilla australiensis
Chondrilla agglutinans
Tetilla dectyloidea
Cellius redieyi
Cellioides fibrosa
Reniera permollis
Reniera topsenti
Reniera hornelli

Fishes

Common Name	Scientific Name
Jew Fish	<i>Protonibea diacanthus</i>
Threadfin	<i>Polynemus indicus</i>
Rock Perch	<i>Otolithoides biauritus</i>
Rosy Jew Fish	<i>Rosy Jew Fish</i>
Banded Jew Fish	<i>Banded Jew Fish</i>
Silver Pomfret	<i>Silver Pomfret</i>
Chinese Pomfret	<i>Chinese Pomfret</i>
Black Pomfret	<i>Black Pomfret</i>
Grey Mullet	<i>Grey Mullet</i>
Mullet	<i>Mullet</i>
Mullet	<i>Mullet</i>
Mullet	<i>Mullet</i>
Seer Fish	<i>Seer Fish</i>
Seer Fish	<i>Seer Fish</i>
Parrot Fish	<i>Parrot Fish</i>
Black Bream	<i>Black Bream</i>
Red Bream	<i>Red Bream</i>
Silver Bidy	<i>Silver Bidy</i>
Coral Trout	<i>Coral Trout</i>
Razor Edge	<i>Razor Edge</i>
Silver Bar	<i>Silver Bar</i>
Eel	<i>Eel</i>
Eel	<i>Eel</i>
Catfish	<i>Catfish</i>
Ribbon Fish	<i>Ribbon Fish</i>
Leather Fish	<i>Leather Fish</i>
Anchovy	<i>Anchovy</i>
Hilsa	<i>Tenulosa ilisha</i>
Hilsa	<i>Tenulosa toli</i>
Indian Salmon	<i>Eletheronema tetradactylum</i>
Indian Salmon	<i>Epinephelus fasciatus</i>
Reef Cod	<i>Epinephelus fario</i>

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

	Common Name	Scientific Name
Prawns	Jumbo/White Prawn	<i>Penaeus indicus</i>
	Banana Prawn	<i>Penaeus merguensis</i>
	Jumbo/King Prawn	<i>Penaeus monodon</i>
	Jumbo	<i>Penaeus semisulcatus</i>
	Jinga	<i>Metapenaeus affinis</i>
	Jinga	<i>Metapenaeus monoceros</i>
	Jinga	<i>Metapenaeus brevicornis</i>
	Jinga	<i>Metapenaeus kntchensis</i>
	Jinga	<i>Parapeneopsis sculptilis</i>
	Jinga	<i>Parapeneopsis stylifera</i>
	Jinga	<i>Solenocera indica</i>
	Jinga	<i>Hippolysmata ensirostris</i>
	Jinga	<i>Hippolysmata vittata</i>
Sharks	Common Name	Scientific Name
	Hammer-headed Shark (arrow head)	<i>Sphyrna blochii</i>
	Hammer-headed Shark (squat head)	<i>Sphyrna tudes</i>
	Rusty Shark/ Giant Sleepy Shark	<i>Nebrius ferrugineus</i>
	Zebra Shark	<i>Stegostoma varius</i>
	Man-eating Shark	<i>Alopias vulpinus</i>
	Marbeled Catshark	<i>Atelomycterus marmoratus</i>
	Whale Shark	<i>Rhincodon typus</i>
	Tiger Shark	<i>Galeocerdo cuvier</i>
Molluscs	Common Name	Scientific Name
	Common Octopus	<i>Octopus vulgaris</i>
	Telescope Shell	<i>Telescopium telescopium</i>
	Pinna	<i>Pinna bicolor</i>
	Pearl Oyster	<i>Pinctada fucata</i>
	Brown Mussel	<i>Perna perna</i>
Echinoderms	Common Name	Scientific Name
	Sea Cucumber	<i>Holothuria sp.</i>
	Brittle Star	<i>Ophiacantha sp.</i>
Crabs	Common Name	Scientific Name
	Fiddler Crab	<i>Uca annulipes</i>
	Mangrove Swimming Crab	<i>Thalamita crenata</i>
	Shore Crab	<i>Grapsus albolineatus</i>
	Shore Crab	<i>Plagusia dentipes</i>
	Spider Crab	<i>Chirostylus sp.</i>
	Ghost Crab	<i>Ocypode ceratophthalma</i>
	Common Crab	<i>Ocypode sp.</i>
	Reef Crab	<i>Carpilius convexus</i>
Mud Crab	<i>Scylla serrata</i>	

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

	Common Name	Scientific Name
Crabs	Neptune Crab	<i>Naptonus pelagicus</i>
	Red-eyed Crab	<i>Eriphia sebana</i>
	Sargassum Crab	<i>Varuna litterata</i>
	Box Crab	<i>Calappa hepatica</i>
	Sponge Crab	<i>Dromodiopsis edwardsi</i>
	Sand Crab	<i>Charybdis truncata</i>
	Hermit Crab	<i>Clibanarius humilis</i>
	Sand Crab	<i>Portunus longiceps</i>
Sea Snakes	Common Name	Scientific Name
	Yellow Snake	<i>Hydrophis spiralis</i>
	Annulated Snake	<i>Hydrophis cyanocinctus</i>
Sea Turtles	Common Name	Scientific Name
	Green Turtle	<i>Chelonia mydas</i>
	Olive Ridley Turtle	<i>Lepidochelys olivacea</i>
	Leatherback Turtle	<i>Dermochelys coriacea</i>
Sea Mammals	Common Name	Scientific Name
	Common Dolphin	<i>Delphinus delphis</i>
	Bottlenose Dolphin	<i>Tursiops truncatus</i>
	Chinese White Dolphin	<i>Sousa chinensis</i>
	Finless Porpoise	<i>Neophocaena phocaenoides</i>
	Dugong	<i>Dugong dugon</i>
Aquatic Birds	Common Name	Scientific Name
	Great Crested Grebe	<i>Podiceps cristata</i>
	Black-necked Grebe	<i>Podiceps nigricollis</i>
	Little Grebe	<i>Podiceps ruficollis</i>
	Great White Pelican	<i>Pelecanus onocrotalus</i>
	Spot-billed Pelican	<i>Pelecanus philippensis</i>
	Dalmatian Pelican	<i>Pelecanus crispus</i>
	Great Cormorant	<i>Phalacrocorax carbo</i>
	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>
	Little Cormorant	<i>Phalacrocorax niger</i>
	Darter	<i>Anhinga melanogaster</i>
	Grey Heron	<i>Ardea cineria</i>
	Purple Heron	<i>Ardea purpurea</i>
	Little Heron	<i>Butorides striatus</i>
	Indian Pond Heron	<i>Ardeola grayii</i>
	Cattle Egret	<i>Bubulcus ibis</i>
	Great Egret	<i>Cusmerodius albus</i>
	Intermediate Egret	<i>Mesophoyx intermedia</i>
	Little Egret	<i>Egretta garzetta</i>

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

Aquatic Birds

Common Name	Scientific Name
Western Reef Heron	<i>Egretta gularis</i>
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>
Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>
Black Bittern	<i>Ixobrychus flavicollis</i>
Painted Stork	<i>Mycteria leucocephala</i>
Asian Openbill	<i>Anastomus oscitans</i>
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>
Black-headed Ibis	<i>Threskiornis melanocephalus</i>
Black Ibis	<i>Pseudibis papillosa</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Eurasian Spoonbill	<i>Platalea leucorodia</i>
Greater Flamingo	<i>Phoenicopterus ruber</i>
Lesser Flamingo	<i>Phoenicopterus minor</i>
Lesser Whistling Teal	<i>Dendrocygna javanica</i>
Ruddy Shelduck	<i>Tadorna ferruginea</i>
Northern Pintail	<i>Anas acuta</i>
Common Teal	<i>Anas crecca</i>
Spot-billed Duck	<i>Anas poecilorhyncha</i>
Common Pochard	<i>Anas ferina</i>
Tufted Duck	<i>Anas fuligula</i>
Comb Duck	<i>Sarkidiornis melanotos</i>
Pygmy Goose	<i>Nettapus coromandelianus</i>
Brahminy Kite	<i>Haliastur indus</i>
Osprey	<i>Pandion haliaetus</i>
Common Crane	<i>Grus grus</i>
Common Moorhen	<i>Gallinula chloropus</i>
Purple Swampphen	<i>Porphirio porphyrio</i>
Common Coot	<i>Fulica atra</i>
Pheasant-tailed Jacana	<i>Hydrophaseanus chirurgus</i>
Bronze-winged Jacana	<i>Metopidius indicus</i>
Eurasian Oystercatcher	<i>Haemantopus ostralegus</i>
Black-winged Stilt	<i>Himantopus himantopus</i>
Pied Avocet	<i>Recurvirostra avocetta</i>
Crab-plover	<i>Dromas ardeola</i>
White-tailed Lapwing	<i>Vanellus leucurus</i>
Red-wattled Lapwing	<i>Vanellus indicus</i>
Yellow-wattled Lapwing	<i>Vanellus malabaricum</i>
Grey Plover	<i>Pluvialis squatarula</i>
Jack Snipe	<i>Lymnocyptes minimus</i>

**Annexure I (Cntd...)
Ecological Diversity of MNP**

Ecological Diversity of MNP

	Common Name	Scientific Name
	Black-shouldered Kite	<i>Elanus caeruleus</i>
	Black Kite	<i>Milvus migrans</i>
	Shikra	<i>Accipiter badius</i>
	Pallid Harrier	<i>Circus macrourus</i>
	Montagu's Harrier	<i>Circus pygarrus</i>
	Hen Harrier	<i>Circus cyaneus</i>
	Peregrine Falcon	<i>Falco peregrinus</i>
	Red-necked Falcon	<i>Falco chirurgus</i>
	Common Kestrel	<i>Falco tinnunculus</i>
	Grey Francolin	<i>Francolinus pondicerianus</i>
	Indian Peafowl	<i>Pavo cristatus</i>
	Macqueen's Bustard	<i>Chlamydotis macqueeni</i>
	Indian Courser	<i>Cursorius coromandelicus</i>
	Rock Pigeon	<i>Columba livia</i>
	Eurasian Collared Dove	<i>Streptopelia decaocto</i>
	Laughing Dove	<i>Streptopelia senegalensis</i>
	Rose-ringed Parakeet	<i>Psittacula krameri</i>
	Asian Koel	<i>Eudynamis scolopaces</i>
	Pied Cuckoo	<i>Clamator jacobinus</i>
	Spotted Owlet	<i>Athene brama</i>
Terrestrial Birds	Indian Nightjar	<i>Caprimulgus asiaticus</i>
	House Swift	<i>Apus affinis</i>
	Asian Palm Swift	<i>Cypsiurus balasiensis</i>
	European Roller	<i>Coracias garrulus</i>
	Indian Roller	<i>Coracias benghalensis</i>
	Common Hoopoe	<i>Upupa epops</i>
	Ashy-crowned Sparrow Lark	<i>Eremopterix grisea</i>
	Black-crowned Sparrow Lark	<i>Eremopterix nigriceps</i>
	Asian Short-toed Lark	<i>Calandrella chelensis</i>
	Barn Swallow	<i>Hirundo rustica</i>
	Bay-backed Shrike	<i>Lanius vittatus</i>
	Great Grey Shrike	<i>Lanius excubitor</i>
	Black Drongo	<i>Dicrurus macrocercus</i>
	Common Myna	<i>Acrideotheres tristis</i>
	House Crow	<i>Corvus splendens</i>
	Common Babbler	<i>Turtoides caudatus</i>
	Jungle Babbler	<i>Turtoides striatus</i>
	Ashy Prinia	<i>Prinia socialis</i>
	Eurasian Reed Warbler	<i>Acrocephalus scirpaceus</i>
	Purple Sunbird	<i>Nectarinia asiatica</i>
	House Sparrow	<i>Passer domesticus</i>
	Baya Weaver	<i>Ploceus philippinus</i>

Annexure 2
Workshop Proceedings 08th March, 2016, Hotel Vishal Jamnagar

Inaugural Session:

Welcome Address

Mr. Rohit Magotra, *Assistant Director, IRADe*

Opening Remarks

Dr. J. Michael Vakily, *Team Leader, CMPA, GIZ*

Inaugural Address

Dr. H. S. Singh, *Ex PCCF & Chairman, Gujarat Biodiversity Board and Member, National Board for Wild Life*

Special Address

Mr. Bharat Pathak, *(IFS) Ex Director, GEER Foundation*

Keynote Address

Mr. Shyamal Tikadar, *(IFS) CCF, MNP Circle, Government of Gujarat*

Welcome Address: Mr. Rohit Magotra, *Assistant Director, IRADe*

Mr. Magotra welcomed the participants to the workshop and conveyed a short message on conservation of Marine National Park on behalf of Dr. Jyoti Parikh, Executive Director, IRADe. He briefed the participants about the project and its objectives. He also emphasized on the necessity of conducting research on Protected Areas of the country.

Opening Remarks: Dr. J. Michael Vakily, *Team Leader, CMPA, GIZ*

Dr. Vakily briefed audience about the project and emphasized on the requirement of such studies for conservation and management of MPAs and promised the support of GIZ to such endeavors. He briefed that MNP was established with the objectives of conservation of marine biodiversity. Over a period of time there are anthropogenic pressure which has affected the MNP. We need to understand this and derive lessons for better management of MNP.

Inaugural Address: Dr. H. S. Singh, *Ex PCCF, Gujarat*

Dr. Singh provided a detailed overview of Marine National Park, Gulf of Kachchh. He emphasized the need of studying in detail the biodiversity of MNP including mangroves, coral reefs, sea turtles, dugongs, dolphins and whale sharks. Regarding mangroves, Dr. Singh expressed satisfaction that the situation of mangroves has improved considerably, since the time he was the director of MNP; but there is need to study other life-forms of MNP to know their status. He also suggested to carry out studies about the effectiveness of MPAs. He asserted that marine areas will play a very important role in future, especially in the sectors of food and fuel security. Considering the importance of marine/oceanic regions, it has been decided to preserve 10% of the total oceanic coverage under protected areas. At present close to 3% of the total oceanic areas has been preserved. At the same time, it is necessary to allow sustainable use of resources within the conserved/protected areas. We must use science & technology to achieve this objective.

Special Address: Mr. Bharat Pathak, (IFS) Ex Director, GEER Foundation

Mr. Pathak emphasized the national as well as international importance of national parks and sanctuaries. He suggested to adopt a landscape approach for the better management of MNP, as this around 640 sq. km area is impacted by various activities carried out in different parts of the Gulf.

Keynote Address: Mr. Shyamal Tikadar, (IFS) CCF, MNP Circle

Mr. Tikadar hoped that the present deliberation will make him wiser regarding the management and other aspects related to MNP.

Second Session: Technical presentation by IRADe: Review of Status of MNP

Chair: Mr. Bharat Pathak, (IFS) Ex Director, GEER Foundation

- **Technical Presentation by Mr. Rohit Magotra, Mr. Mohit Kumar and Mr. Pushkar Pandey**

The second session was chaired by Mr. Bharat Pathak. The session begins with briefing of the audience about IRADe and its activities by Mr Rohit Magotra. Technical presentation began with briefing about the project and its objectives. Then he spoke about the chronology of various events that have impacted MNP over the years since its inception. Broadly, the methodology of the study has four components:

- a. Identification and mapping of various stakeholders associated with MNP&S
- b. Assessment of stakeholder's impacts on MNP&S (Threats & Pressures on MNP&S)
- c. Ecological status of MNP&S with specific reference to mangroves and coral reefs
- d. Review of Governance and management plans

Results indicate that most of the fishermen surveyed across different villages accept MNP and its biological habitats (such as mangroves, coral reefs and seagrasses) beneficial for fishing. The possibility of any conflict between fishermen and MNP department was completely ruled out. However, most of the fishermen were ignorant about existence of any MNP management plan. Encouragingly, most fishermen (including women) were eager to participate in the affairs related to MNP and even demanded that they should be informed about all the meetings/discussions associated with MNP that are being/ will be carried out. They also raised the concerns regarding illegal fishing and urged the authorities to take stringent measures to curb this menace. Fishermen also realized that establishment of industries along the coast has boosted employment but simultaneously has contributed to the degradation of MNP.

Mr. Gaurav Ghatak, Marine Operations, IOCL commenced by highlighted the fact that dynamic industrial expansion and its activities along the coast of Jamnagar and in vicinity to the Marine National Park has somewhere deteriorated the environment of sea and damaged the biodiversity. Further he emphasized that there is a need for establishment of a mechanism or policy for sustainable conservation of Marine area and its biodiversity. We should progressively try to adapt best international environmental policies or mechanisms to bring evolution in conservation activities. Industries should also follow the government policies setup for pollution control which somewhere is lacking. With rising industrial and fishing activities in Gulf of Kachchh, it has become essential for everyone to adapt to new and advanced technology that will help the to become more efficient and productive which somewhere benefit them as well.

Mr. Micheal Vakily, Team Leader, CMPA, GIZ gave his inputs on the fishermen survey and said that there is need to establish a forum where all such data and other data related to MNP or any other Marine Protected Area and its biodiversity can be put together which can help researchers in future research.

Mr. Suleman, Fishermen representative from Sachana, said the expansion have benefits the fishermen, as these forests act as a habitat for marine fishes helping in managing the fish production.

Mrs. Jarinaben Suleman Sama representative from fishing community, said there is a need to establish a mechanism of spreading all the MNP conservation related communications in local language. She also put light on the harmful impacts caused by people coming from outside roaming in the day on the reef areas and when fishermen venture out in night in search of marine organisms such as crabs, conch, shells, etc., they found difficulty in collecting these organisms as walking on coral reefs harm reef biota and fishermen families which depends on reefs for their livelihood suffer.

Mr. Amin, Salaya Machimar Ltd. Commence with informing the audience that majority of population residing in the coastal villages starting from Navalakhi to Okha belongs to Muslim community. He informed and presented the results of the survey work on fish population of Jamnagar coast carried out by Salaya fishing association. As per the survey, in past 3-4 years fish population in the sea along the Jamnagar coast has declined. He also said in past three decades in the name of development large scale companies are expanding along the Jamnagar coast. Due to industrial expansion, they have witnessed decrease in rainfall, increase in temperature, contamination of sea water and other environmental problems. He also emphasized that government should launch some scheme which can support fishermen in capacity building through training programmes. Fishing community should be encouraged by government to adapt to advanced fishing techniques/ instruments by giving them subsidies. He also

emphasized that government should launch some scheme which can support fishermen in capacity building through training programmes. Fishing community should be encouraged by government to adapt to advanced fishing techniques/ instruments by giving them subsidies. He also said there is a need to properly monitor and implement policies to control industrial pollution. Monitoring of industrial pollution should be done strictly to control illegal hot water discharge, dredging and other destructive activities. He concluded by saying development is good but it should be done in sustainable form along with taking care of their surrounding environment and biodiversity. He further said evolution should remain progressive but not retrogressive with sustainable conservation of environment.

Dr. Vaibhav Mantri, Senior Scientist, CSMCRI, emphasized more on providing or involving fishermen into diversified livelihood options. Instead of stopping them from doing fishing in that areas it's better to involve them in other activities such as seaweed farming, etc.

Mr. Rajesh Shah, ESSAR, suggested researchers to conduct perception survey of industries along with other stakeholders as well. It is also essential to highlight conservation work done by industries, if any such as mangroves plantation. It is also the responsibilities of industries to bring all the data related to conservation activities in public domain.

Dr. Dhiraj Chavada, Marine Biologist MNP, also touched upon the importance of developing and providing other better livelihood options to fishermen within that area. He said seaweed farming can be developed as another livelihood option along with, aqua culture and mericulture (marine cultivation) apart from fishing. He also informed the audience that sedimentation is one of the major problem in the area. They have found sedimentation of 1-2 cm in some of the islands of MNP.

Mr. Prakshal Mehta, Founder WAY, put his observation on the issue and said somewhere we are missing out one of the important stakeholders like school children's and young adults who are not even in touch and aware of this biodiversity and resources around. Ideal way is to provide awareness and inform them about significance of the MNP&S and its biodiversity in the same way we are trying for fishing community.

Third Session: Evolving Common Vision Statement for Management of MNP

Chair: Dr. H. S. Singh, Ex PCCF, Government of Gujarat

Panelists:

Dr. H. B. Chauhan, Scientist/Engineer "SF", SAC, Ahmedabad

Mr. Shyamal Tikadar, (IFS) CCF, MNP Circle, Government of Gujarat

Mr. Jaydev Nansey, Environment Specialist

Dr. Aeshita Mukherjee, Technical Expert, CMPA, Gujarat, GIZ

Dr. Pratik Mehta, Head-HSE, ESSAR Power, Industry Representative

Jarinaben Suleman Sam, Fishermen Representative

Mr. Shyamal Tikadar :

Mr. Tikadar stated that MNP has various stages of transition at every stage of its evaluation, appropriate and relevant management efforts that have gone into MNP to make MNP what it is today. The way MNP is marketed perceived today among all the stakeholders is quite evident as was shown in the data this morning.

He said "What is more relevant is to access what is MNP's role and where does MNP stand today's development context, fisheries context and the stakeholders involved. In the present scenario where does MNP fit in is something that we have to look at."

He also touched upon the importance of whole Gulf of Kachchh and emphasize on the fact it is necessary to keep in mind that it's just about 600 km² of notified protected area in the form of sanctuary or National Park. In a landscape of 7500 km² of there are lots of things to look upon and asked what are those lots of things and those priorities. According to him those lots of things begin with significance of this Gulf nationally and internationally and its rich history, which can't be ignored. It has always been a trade route, nearest access point for the western world and India. It's a major oil hub today and area for security concern.

There are lots of fisherman who are dependent on its for their livelihood and their economy dependent upon this area. In this mosaic all this is happening in a very dynamic situation. It changes every six hours where the water tide comes in and it goes out and along with these things what kind of affect it has on humanity. As per Mr. Tikadar's perception, whatever management inputs we put in on part of the government should ultimately targeted towards us. If we are investing in term of tax collected, all this investment must come back to the society in tangible or intangible way., if tangible that would be better.

According to him, today our task would be to establish a link between the protected area, the investment incurred in the protected area and the outcomes has to be assessed in terms of fish yield and if we can drop some linkages over there and find what is the correlation and depending on that have appropriate strategy so as to ensure that the fish production increase and at the same time the ecological identity is maintained.

In today's context another very important thing that he feels is that in past management regime may be appropriate but in tomorrow's time to come with so many stakeholders and huge economy is at stake. Some thought has to be given in management regime as well because there are lots of legalities and intricacies involved has to be taken in the appropriate way.

Mr Jaydev Nansey

Mr. Nansey emphasized that there is a need to create an inventory of baseline data associated with biodiversity of MNP. He asserted that declaration of this region as MNP has benefitted fishermen immensely, as this leads to protection of mangroves (cher) which acts as a habitat for marine fishes. He also stressed on the need to target vulnerable sections while developing future plans and policies for MNP. The vulnerable sections include: endemic and endangered species, unskilled fishermen, women headed household, schedule caste households, and low income group fishermen. Mr. Nansey also emphasized on the need to prepare a focused policy document for better management of MNP. He also stressed on the need to prepare a species specific management plan with inputs from ecologists, coastal zone experts, fisheries expert and port and shipping experts. In addition, he also raised the concern to prepare a skill development and livelihood specific management plan with inputs from social scientists, gender experts, skill development specialists, fisheries expert, and coastal zone management expert. He urged the corporate sector to fund conservation projects and provide employment opportunities to local semi-skilled and unskilled fishermen.

Dr. H B Chauhan

Dr. Chauhan said that development is inevitable, however, it must be ensured that the development projects cause minimum harm to the environment. He further elaborated the role of Indian Space Research Organization towards the monitoring of MNP. He also informed that with the advent of advanced microwave and hyperspectral satellite data, more research shall be carried out in MNP. Additionally, he informed the gathering that ISRO and NASA have collaborated to launch a microwave satellite named NISAR (NASA/ISRO Synthetic Aperture Radar) in 2020. The combined use of optical and microwave data shall be helpful in classifying the mangroves at species level.

Dr. Pratik Mehta

Dr. Mehta said all industries will not have expert in the field of environment but if they can be guided in a proper way it can go along with that i.e. industrial development and conservation of MNP. We need to have a cautious approach when going to mangroves plantation. Essar has done mangroves plantation for which they consulted forest department and requested for community participation to do so.

He also said that Transplantation or introduction of coral species as per international examples also we can note that whenever we introduce species to a different environment we should be follow cautious approach. We need to look at what adverse effect or mid positive or negative especially when we are working in an extremely fragile ecosystem like corals.

Dr. Mehta assured the participants by saying that industries can definitely participate in the conservation plan of MNP whenever it is required. He pointed out that Forest Department is preparing next conservation plan (2016-17) for MNP and according to him, industry role should be well defined in the management plan.

He also touched upon significance of accumulating all the MNP&S related research information/data at one place. According to him, authorities should take lead in that we have huge amount of data available in terms of say water quality, sediment quality, corals, etc. Rightly said it is available in fragmented places. Many research organisations/ independent researches and other people are trying to gather information from so many places to try to put it in one place. If authorities can combine all the fragmented data in one place, then it will give a good outcome cost wise as well as the use of data.

Dr. Aeshita Mukherjee

Dr. Mukherjee began with highlighting the importance of participatory approach which ensures livelihood security of the community. She emphasized that landscape approach is required for MNP management.

According to her Forest department is not the only agency responsible for management and conservation of MNP rather each stakeholder should understand their responsibility to conserve MNP. There is need to establish a mechanism for coordination among various departments / stakeholders. It is very important to document what is available at MNP because we can appreciate something only when we know it. Further, she suggested vision statement for MNP

- Provide stewardship of our natural resources, cultural and historical resources that is pivotal to the National Park. She said we drive lot of valuable intangible services for MNP.

Dr. Bharat Pathak:

According to Mr. Pathak, when we say protection against something or against certain threats. As in the case of pollution we have adopted a principal. Those who are potential polluters they must take steps to control pollution. It goes much beyond CSR (Corporate Social Responsibility).

Oil spill is not in the interest of the industry, the fishermen, the biodiversity or anybody. According his view, industries should invest in such a way so that oil spills are prevented and monitored in such a way that chances of Oil spill even if at present it is 1% should come down to 0.1%.

Mr. Pathak asserted the need to identify the potential areas of mangrove regeneration. He further addressed the need to study the reasons which led to the extinction of Acropora in this region before attempting transplantation of Acropora in MNP.

Another aspect highlighted by Mr. Pathak was that when we set the management plan for biodiversity or something it is always for long term; it cannot be for 10 years. This vision stamen cannot be for 10 years, it has to be long term and “long term” we have started using as a pre-requisite for all such biodiversity conservations plans. Long Term perpetual or never ending posterity (means all future generations of people), especially mentioned otherwise there is no point.

Mr. Tikadar interrupted by saying we cannot have something for posterity. Mr. Pathak replied back by saying we are not here talking about policy and strategy; we are discussing about Vision for MNP. If we are not conserving mangroves and corals for now, long term has to be the principle. Mr. Pathak concluded by saying that we cannot go changing vision statement every 10 year.

Dr. H S Singh, in response to a comment of Mr. Pathak that instead of mangrove plantation we should use the term mangrove densification, as over the years mangrove cover has increased but the density has remained relatively constant, Dr. Singh opined that the density of mangroves in Gujarat is relatively constant over the years due to natural limitations. Gulf of Kachchh has semi-diurnal tidal conditions which restricts the growth of mangroves upto 4-5 meters. In contrast, mangroves in West Bengal and Andaman may reach upto the heights of 20-70 meters which makes the forest denser. Dr Singh also emphasized the importance of traditional/local knowledge in the management of MNP. He added that the vision statement should not be more than 6-7 lines. To increase the fish production, he advocated:

Annexure 2 (Cntd...)
Workshop Proceedings 08th March, 2016, Hotel Vishal Jamnagar

1. To increase the extent of mangroves in MNP with a view to increase fish production,
2. To prohibit fishing during the breeding season,
3. To prohibit the use of nets with small pores

Dr. Singh also stressed sensitizing the local communities through development of an individual and separate development plan for each of the 52 villages in MNP by ensuring local participation. He also emphasized the need to prepare all the concerned document in local language (Gujarati).

Conclusion:

The workshop came to an end with Dr. Singh thanking all the speakers and participants for presenting their views and urged IRADe to circulate the draft vision statement to the stakeholders.

It was recognized that industrial activity do harm the environment however, industrial representatives were eager to support the conservation efforts towards sustaining the marine diversity. It was also recognized that proper management of Marine National Park require a seascape/landscape approach which will incorporate the study of impact of different activities in the entire Gulf on MNP.

PARTICIPANTS

List of the Participants	
Dr. H. S. Singh	Ex PCCF & Chairman, Gujarat Biodiversity Board and Member, National Board for Wild Life
Mr. Bharat Pathak	Ex Director, GEER Foundation
Mr. Jaydev Nansey	Environment Specialist
Mr. Shyamal Tikadar	CCF, MNP Circle, Government of Gujarat
Dr. J. Michael Vakily	Team Leader, CMPA, GIZ
Dr. Aeshita Mukherjee	Technical Expert, GIZ
Dr. R. B. Thorat	Principal Scientist, Head, Marine Environment Group, CSMCRI
Dr. Vaibhav Mantri	Senior Scientist, CSMCRI
Dr. H B Chauhan	Scientist/Engineer "SF", SAC, Ahmedabad
Mr. Ratheesh Ramakrishnan	Scientist/Engineer "SD", SAC, Ahmedabad
Mr. Pradeep. S. Dave	GPCB, Jamnagar
Mr. K. R. Malviya	GPCB, Jamnagar
Mr. Rajesh Shah	ESSAR
Dr. Pratik Mehta	Head-HSE, ESSAR
Ms. Ashmita Patel	Senior Manager, Environment, ESSAR
Adam Bhaya	Sailing Vessels Associations
Mr. Gaurav Ghatak	Marine Operations, IOCL
Mr. Anand Kumar Sutharia	Reliance Industry Ltd.
Mr. Prakshal Mehta	Founder, WAY
Mr. Shrikant Verma	IGNFA, Dehradun
Dr. Dhiraj Chavda	Marine Biologist, MNP department, Jamnagar
Mr. Ketan Ramani	Social Scientist, Marine National Park, Jamnagar
Ms. Parvati N Gohil	Social Scientist, Marine National Park, Jamnagar
Mr. Kunal J Joshi	Nature Education and Awareness Trust (NEAT)
Mr. B. H. Dave	ACF, MNP, Jamnagar
Mr. Amit Mishra	IGNFA, Dehradun
Dr. S. Senthil Kumar	IGNFA, Dehradun
Mr. Mustak Amin	Hotel President, Jamnagar
Fishermen Association	<ol style="list-style-type: none"> 1. Akta Charitable Trust Okha: Mr. S. A. Baloch 2. Jetlani Trust Poshitra: Mr. Suleman Hussain Sama and Mrs. Jarinaben Suleman Sama 3. Sagar Khadu Fishermen Association: Mr. Anwar 4. Salaya Machimar Ltd.: Mr. Aamin
Other Fishermen	<ol style="list-style-type: none"> 1. Mr. Imran Sameja 2. Mr. Hunif 3. Mr. Firoz Mohummad Sidik 4. Mr. Hunadada Mahmad Iqbal Karim\ 5. Mr. Ismail Hunadada

The CMPA Project

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Established to support the achievement of the Aichi targets of the Convention on Biological Diversity, the Project’s overall goal is to contribute to conservation and sustainable use of biodiversity in selected areas along the coast of India. Taking into consideration the economic importance of the coastal zone for large segments of the population, the Project’s approach is people-centered, thus ensuring the support for conservation by those depending on coastal ecosystems.

Review of Status of Marine National Park, Jamnagar: Evolving a Vision Statement for Management of MNP

March 2016

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