सत्यमेव जयते
ગુજરાત સરકાર

Marine National Park and Sanctuary, Jamnagar

State of Gujarat, India

2015 Ecosystem Health Report Card

Ministry of Environment, Forests and Climate Change

National Centre for Sustainable Coastal Management

Gujarat Ecology Commission Gandhinagar

Marine National Park, Jamnagar

Potential pressures affecting the MNPS ecosystem

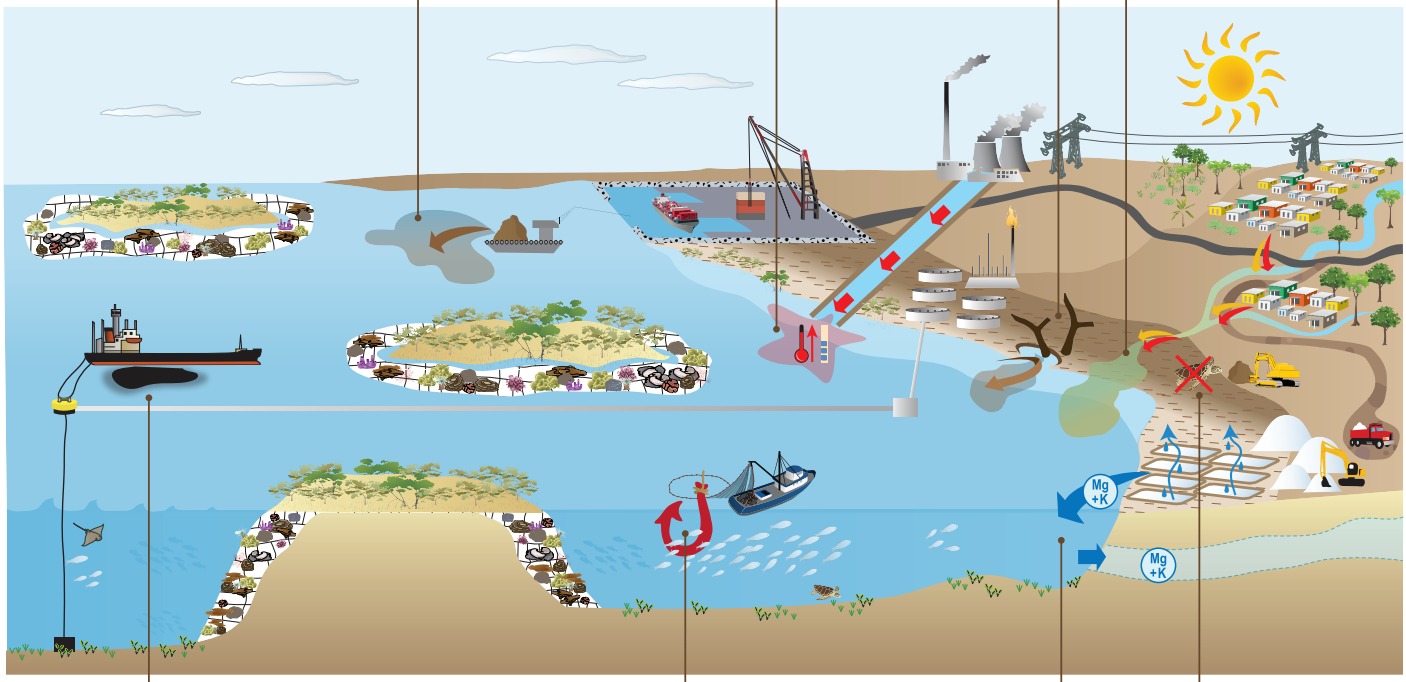
On the southern coast of the Gulf of Kachchh, the Marine National Park and Sanctuary– Jamnagar (MNPS) is subjected to constant pressures from both natural processes and human activities. The problems highlighted here are pollution, overfishing, and erosion, all of which can result in a degradation of the marine habitat. By identifying these pressures through efforts like this ecosystem health report card and subsequent management actions, the likelihood of the MNPS to sustain itself is improved.

With increased **port development** and subsequent deep-sea dredging activities, sediment may be deposited on corals.

Used to cool **power plants**, seawater discharged from an open system may affect sea temperatures and pH, leading to mangrove death and a reduction in fisheries.

While banned, **mangrove cutting or destruction** makes the coast more vulnerable to erosion and destroys fish nursery habitat.

The direct release of **urban area waste and sewage** into tributaries or the sea may cause an excess of nutrients and toxics.



With an increasing number of **ships and tankers** at single point moorings, there is an enhanced risk of oil spills.

Increasingly intensive **fishing** pressure and increased **bycatch** may lead to biodiversity loss and fisheries declines.

Evaporative **salt pans** discharge bittern, (concentrated magnesium and potassium salts) into the sea, potentially increasing salinity in the groundwater and soil.

Unregulated **coastal development** and **illegal mining** can result in fewer sea turtle nesting sites.

Restoration of mangroves and corals, and improving sea turtle survival in the MNPS

The diverse marine life of the Gulf rely on coral reefs for habitat, which, in turn, provides livelihoods for local communities. To offer protection to these fragile ecosystems, the Marine National Park and Sanctuary– Jamnagar (MNPS) was created in 1982.

Mangroves provide shoreline protection and support the marine ecosystem of the Gulf. Threatened by deforestation, the MNPS began mangrove plantations in 1983.

To conserve and restore corals, the MNPS relocated corals in the way of oil infrastructure development in 2005, and began a coral transplantation pilot project in 2012.

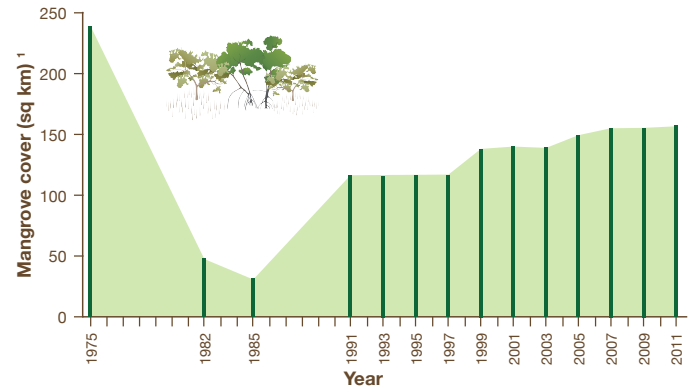
Sea turtle grazing maintains the balance between seaweeds and seagrass, and other marine organisms. Various disturbances have affected the habitat of the two species that nest here. To support those populations, the MNPS established sea turtle hatcheries.

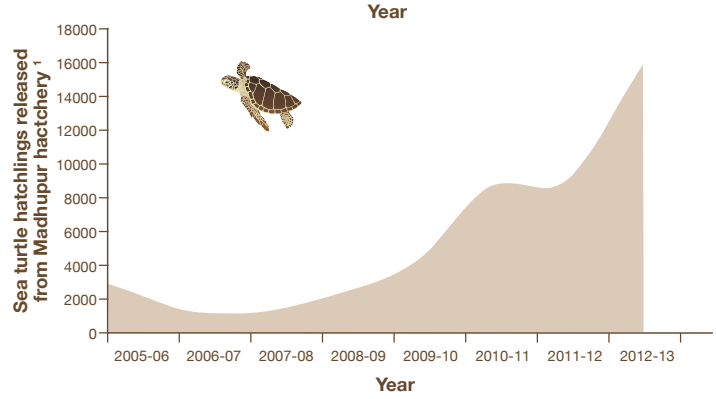
Nischal Joshi, GEC

Mangrove planting

Jane Hawkey, IAN

Coral transplants





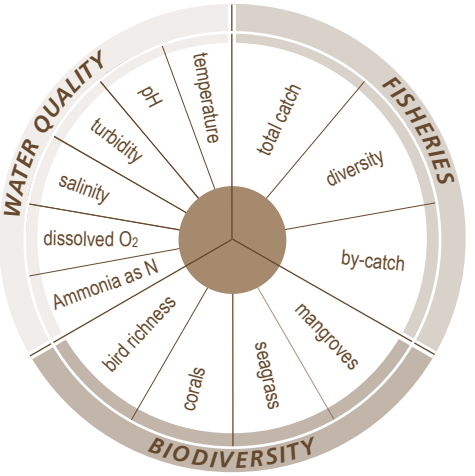
[1] Data source: Marine National Park and Sanctuary– Jamnagar

How the report card was prepared

This is the first Ecosystem Health Report Card for Marine National Park and Sanctuary–Jamnagar (MNPS). The Gujarat Ecology Commission (GEC), in partnership with the National Centre for Sustainable Coastal Management (NCSCM) and the Integration & Application Network (IAN) from the University of Maryland Center for Environmental Science (UMCES), convened a science workshop bringing together local, regional, and international experts and stakeholders. Together, the participants identified 13 indicators of ecosystem health currently monitored within the MNPS, and developed thresholds for each. Additional indicators may be included in future once measures for data collection are in place. This first Report Card serves as a baseline that will be used as a point of comparison to measure progress towards the MNPS management goals and targets in the coming years.

Measures of ecosystem health

Measuring the ecosystem health of the MNPS is conducted using 13 indicators organised into three main indices: **Water Quality, Fisheries,** and **Biodiversity**. Together, these indicators represent the ecosystem features of the MNPS that are valued (e.g., coral reefs, mangroves, seagrass, and birds); and represent the threats (e.g., industrial pollution, urban sewage, salt pan discharge, and overfishing) to these values.



WATER QUALITY

Temperature — Affects many physical, biological, and chemical characteristics of a water body, such as the amount of oxygen that can be dissolved in water, rate of photosynthesis of plants, metabolic rates of animals, and the sensitivity of organisms to toxic wastes, parasites, and diseases.

pH — Measure of how acidic or basic water is. pH determines the solubility and biological availability (including toxicity) of chemical constituents such as nutrients and heavy metals.

Turbidity — Inversely proportional to light penetration which directly affects the photosynthesis rate of marine producers, turbidity affects the dependent organisms succeeding tropic level. Turbidity is one of the responsible factors of coral health.

Salinity — The salinity of seawater measures the total amount of sodium, chloride, and other dissolved salts. The combination of salinity and temperature has a profound effect on ocean density and circulation, though seawater density depends more on salinity than on temperature.

Dissolved oxygen — Critical to the survival of aquatic life. The amount of dissolved oxygen needed before aquatic organisms are stressed, or die, varies from species to species.

Ammonia as N — Ammonia is a nutrient containing nitrogen that can be an important factor controlling algal growth. Ammonia in its un-ionized form (NH_3) can be highly toxic to fish and other aquatic life.

FISHERIES

Total catch — Total catch indicates the abundance of fish. Long-term trends through total catch would help to forecast abundance and sustainable management.

Diversity — Total variability among fishes occurring in the area including dominant, commercially important, and reef-associated species.

By-catch — The incidental capture of non-targeted species of fishes, including juveniles, and other marine species. The by-catch also indicates total diversity and potential harvests. Fisheries data was collected from landing centres that may not refelct conditons in the entire Gulf of Kachchh.

BIODIVERSITY

Bird richness — On the global Indo-Pacific migratory route, the MNPS hosts resident and migratory bird species. Mangroves and other habitats provide feeding and nesting sites for many birds including the threatened species.

Corals — Coral is represented by more than one trophic level and it is more sensitive towards abiotic factors such as temperature, turbidity, and salinity, making coral a good indicator for ecosystem health. There are 34 sites where there is live coral cover in the MNPS.

Seagrass — Out of 14 species found in India, six seagrass species are found in the MNPS. Seagrass is a primary producer for marine life including the vulnerable dugong (*Dugong dugon*) and the green sea turtle (*Chelonia mydas*).

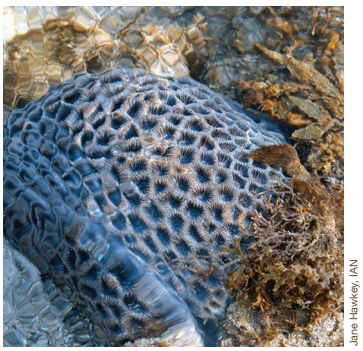
Mangroves — Mangroves are wide-spread in the MNPS intertidal areas and support a diversity of fauna. They also are a barrier against erosion. As such, visible changes in mangrove cover can be directly related to ecosystem health.

Jane Hawkey, IAN

Brittle star exposed at low tide

Jane Hawkey, IAN

Local fishermen



Jane Hawkey, IAN

Coral in clear water

Sonara Amav, Flickr

Migratory water birds

Marine National Park and Sanctuary– Jamnagar 2014 Report Card

Calculating an ecosystem grade for the Marine National Park and Sanctuary–Jamnagar.

The Marine National Park and Sanctuary–Jamnagar was divided into four reporting sectors, each of which received a report card grade. The grades were calculated from the average of water quality, fisheries, and biodiversity indices, using the most up-to-date data available. On-going monitoring will allow grades to be updated on a periodic basis, providing a means to track change over time.

What do the grades represent?

Grades		
A	100-80%	All water quality and biological health meet desired levels.
B	80-60%	Most water quality and biological health meet desired levels.
C	60-40%	There is a mix of good and poor levels of water quality and biological health indicators.
D	40-20%	Some or few water quality and biological health indicators meet desired levels.
F	20-0%	Very few or no water quality and biological health indicators meet desired levels.

Desired conditions guide ecosystem change.

Desired conditions are based on available guidelines, current scientific knowledge, and/or historical data and trends, and take into account the influence of a variable climate from year to year. The table below outlines the desired condition developed or identified for each indicator and the source of this information.

Index	Indicator	Threshold	Source
Water Quality	Temperature	≤ 30° C [1]	
	pH	6.5 - 8.5 [1]	CPCB
	Turbidity	30 NTU [1]	CDA
	Salinity	33 - 39 ppt [1]	
	Dissolved oxygen	≥ 4 mg/L [1]	CPCB
	Ammonia as N	≤ 1.2 mg/L [1]	CPCB
Fisheries	Total catch	mean ± STDEV [2]	calculated
	Diversity	% species landed/expected [3]	calculated
	By-catch	% of total catch - targeted [2]	calculated
Biodiversity	Bird richness	% observed/expected [3]	[6]
	Corals	Ratio live/total (live + dead) [4]	calculated
	Seagrass	% area observed/expected [3]	[6]
	Mangroves	% area observed/expected [5]	GEC

[1] 2012 GPCB data
[2] Jul 2012-Jun 2013 Fisheries Department data
[3] insufficient data
[4] Aug 2012-Mar 2013 GEER and Zoological Soc India data
[5] 2007 GEER data
[6] source to be determined

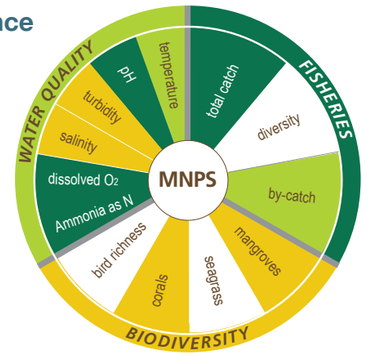
Jane Hawkey, IAN

Both soft corals and sea anemones are found in the reef.

Overall, the Marine National Park and Sanctuary–Jamnagar scored a "B" for ecosystem health based on performance of Water Quality, Fisheries, and Biodiversity indices.

James Hawkey, IAN

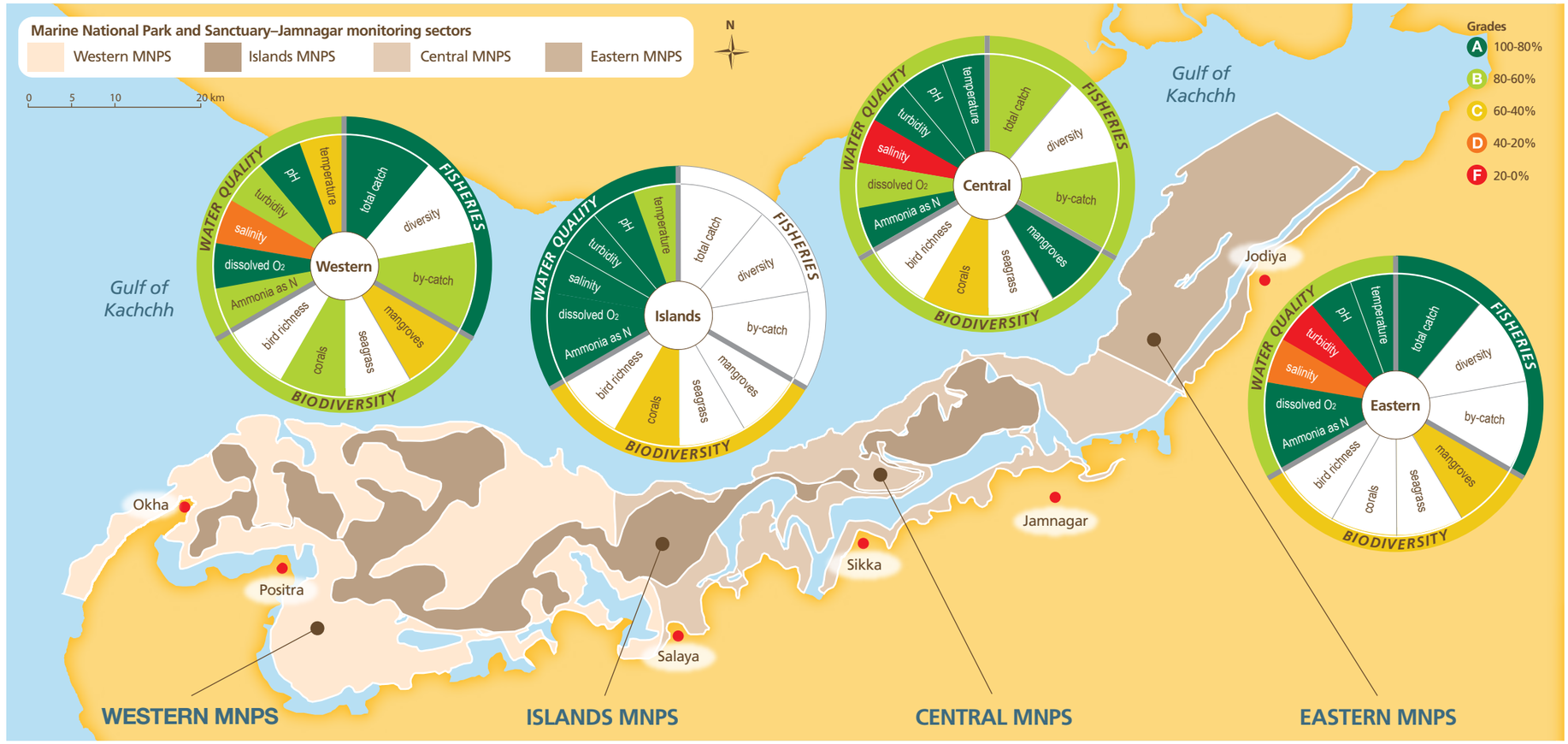
Along the shoreline, an oriental darter (Anhinga melanogaster) dries its wings.



B MARINE NATIONAL PARK AND SANCTUARY–JAMNAGAR

Based on available data, the Marine National Park and Sanctuary–Jamnagar received a "B" due to excellent results for Fisheries, good results for Water Quality, and average results for Biodiversity.

No suitable data and/or threshold was available for bird richness, seagrass area, or fish diversity, resulting in low confidence of scores for the Biodiversity Index and Fisheries Index.



B WESTERN MNPS sector

Based on available data, the Western MNPS sector received a "B" due to excellent results for Fisheries, and good results for Water Quality and Biodiversity (based on live coral cover and mangrove area only).

No sector-specific data was available for bird richness, seagrass area, or for fish diversity, resulting in a low confidence of scores for the Biodiversity and Fisheries indices.

B ISLANDS MNPS sector

Based on available data, the Islands MNPS sector received a "B" due to excellent results for Water Quality, and average results for Biodiversity (based on live coral cover only).

No sector-specific data was available for bird richness, seagrass area, mangrove area, or for total catch, fish diversity, by-catch, resulting in low confidence of scores for the Biodiversity Index and no score for the Fisheries Index.

B CENTRAL MNPS sector

Based on available data, the Central MNPS sector received a "B" due to good results for Fisheries, Water Quality, and Biodiversity (based on live coral cover and mangrove area only).

No sector-specific data was available for bird richness, seagrass area, or fish diversity, resulting in low confidence of scores for the Biodiversity Index and Fisheries Index.

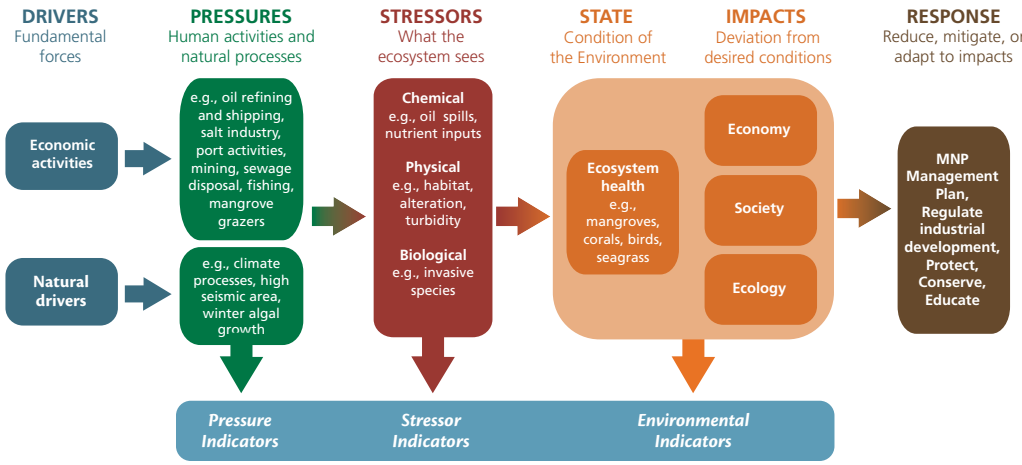
B EASTERN MNPS sector

Based on available data, the Eastern MNPS sector received an "B" due to excellent results for Fisheries (based on total catch only), good Water Quality, and average results for Biodiversity (based on mangrove area only).

No sector-specific data was available for bird richness, live coral cover, seagrass area, fish diversity, or by-catch, resulting in a low confidence of scores for the Biodiversity and Fisheries indices.

Where do we go from here?

The framework for this Marine National Park and Sanctuary–Jamnagar Report Card shown here characterises societal ***drivers***, ***pressures*** from human activities and natural processes, and ***stressors*** that directly affect the ecosystem. The ***state*** of the system and ***impacts*** are compared with desired conditions and lead to societal ***responses*** to improve environmental health.



Recommendations for the future

This report card is based on the best science, data, and information available at the time of the assessment. Future revisions could include the development of locally relevant thresholds and refining data sources. Recommendations to protect and restore ecosystem condition in the MNPS include:

- Undertake mangrove plantations in erosion-prone areas to improve shoreline protection and increase marine nursery habitat
- Undertake coral transplantation and coral translocation at suitable sites to improve coral reef health and improve habitat for aquatic life
- Promote additional artificial reef structures at select sites to encourage recruitment of new marine life
- Reintroduce species that have disappeared or are significantly reduced in population, e.g., Acropora corals and pearl oysters
- Promote ex situ / in situ conservation of sea turtles nest according to habitat
- Support the construction of a tourist boardwalk in the intertidal zone of the MNPS to protect marine life
- Regulate port development and shipping activities
- Regularte mining, dredging, and coastal development
- Promote additional sewage treatment plants to reduce eutrophication and induced algal enrichment
- Build capacity at all levels for technical and managerial skills for the implementation of integrated resource management planning
- Promote biodiversity conservation and education

Workshop participants

Up to 65 participants attended the *Workshop on Marine National Park and Sanctuary of Gulf of Kachchh Ecosystem Heath Report Card*, 2-3 September, 2013, Jamnagar, Gujarat, India, including scientists, engineers, agency managers, industry representatives, and graduate students from: National Centre for Sustainable Coastal Management; Government of Gujarat Ministry of Environment, Forests and Climate Change; Gujarat Ecology Commission; Gujarat Ecological Education and Research Foundation; Marine National Park–Jamnagar; Gujarat Pollution Control Board; Gujarat Maritime Board; Bhaskaracharya Institute for Space Applications and Geo-Informatics; Gujarat Environment Management Institute; Essar Energy; Reliance Industries Ltd; Indian Oil Corporation Ltd; Bharat Oman Refineries Ltd; Indian Coast Guard-Okha; Indian Coast Guard-Vadinar; Indian Naval Service-Okha; and Fisheries Department-Jamnagar.

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This document was produced under The World Bank-aided ICZM Project.

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Acknowledgements

The authors would like to thank the Government of Gujarat Ministry of Environment, Forests and Climate Change (MoEF&CC), Gujarat Ecology Commission (GEC), Gujarat Ecological Education and Research Foundation (GEER), Marine National Park and Sanctuary– Jamnagar (MNPS), Gujarat Pollution Control Board (GPCB), and National Centre for Sustainable Coastal Management (NCSCM) scientists who assembled the data, as well as all the participants and guests of the *Workshop on Marine National Park and Sanctuary Gulf of Kachchh Ecosystem Heath Report Card*, 2-3 September, 2013, Jamnagar, India, for their contributions to this report card.

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Cover photo: Jane Hawkey, IAN-UMCES. Cover photo strip (L to R): bv_madhukar, Flickr ; Elvin Lonan, Flickr ; Jane Hawkey, IAN ; Jane Hawkey, IAN.

Release date: January 2015