

Marine and coastal ecosystems

Coastal habitats such as mangroves, seagrass beds, salt marshes and shellfish reefs continue to decline in extent, threatening highly valuable ecosystem services including the removal of significant quantities of carbon dioxide from the atmosphere; but there has been some slowing in the rate of loss of mangrove forests, except in Asia.

Some of the best-studied examples of recent decline in the extent and integrity of marine habitats are in coastal ecosystems of great importance to human societies and economies. Coastal habitats have come under pressure from many forms of development including tourism and urban infrastructure, shrimp farming and port facilities including dredging. This is compounded by sea level rise, creating what might be termed a “coastal squeeze”.

Mangrove forests are highly-productive ecosystems in the inter-tidal zones of many tropical coastlines. They not only provide wood for local communities, but also act as nursery areas for a wide range of commercially-valuable fish and crustacean stocks, and act as vital energy barriers, protecting low-lying coastal communities from offshore storms. The FAO estimates that about one-fifth of the world’s mangroves, covering 36,000 square kilometres, were lost between 1980 and 2005. The rate at which mangroves are declining globally seems to have reduced more recently, although the loss is still disturbingly high. During the 1980s, an average of 1,850 square kilometres was lost each year. In the 1990s the annual average dropped to 1,185 square kilometres, and from 2000-2005 it was 1,020 square kilometres – a 45% reduction in the annual rate of loss. The trend of reduced rate of loss has not been observed in Asia, which holds a larger proportion of remaining mangroves than any other region.

Seagrass beds or meadows, fringing coastlines throughout the world, perform a number of vital but under recognized ecosystem functions, including support for commercial fisheries, a food source for species such as manatees and dugongs, and the stabilization of sediments. It is estimated that some 29% of seagrass habitats have disappeared since the 19th century, with a sharp acceleration in recent decades. Since 1980, the loss of seagrass beds has averaged approximately 110 square kilometres per year, a rate of loss comparable to mangroves, coral reefs and tropical forests.

Salt marshes, important as natural storm barriers and as habitats for shorebirds, have lost some 25% of the area they originally covered globally, and current rates of loss are estimated to be between one and two per cent per year. Salt marshes are especially important ecosystems for removing carbon dioxide from the atmosphere. For example in the United States they are estimated to account for more than one-fifth of the carbon absorbed by all ecosystems, despite covering a relatively small area.

Shellfish reefs are an even more threatened coastal habitat, and play an important role in filtering seawater and providing food and habitat for fish, crabs and seabirds. It is estimated that 85% of oyster reefs have been lost globally, and that they are functionally extinct in 37% of estuaries and 28% of ecoregions.

The quantity of carbon buried each year by vegetated coastal habitats such as mangroves, salt marshes and seagrass beds has been estimated at between 120 and 329 million tonnes. The higher estimate is almost equal to the annual greenhouse gas emissions of Japan.

Tropical coral reefs have suffered a significant global decline in biodiversity since the 1970s. Although the overall extent of living coral cover has remained roughly in balance since the 1980s, it has not recovered to earlier levels. Even where local recovery has occurred, there is evidence that the new reef structures are more uniform and less diverse than the ones they replaced.

Tropical coral reefs contribute significantly to the livelihoods and security of coastal regions in the areas where they occur, including through tourism based on their aesthetic beauty, income and nutrition from the fish species they support, and protection of coastlines from storms and waves.

Although they cover just 1.2% of the world’s continental shelves, it is estimated that between 500 million and more than one billion people rely on coral reefs as a food resource. Around 30 million people in the poorest and most vulnerable coastal and inland communities are entirely dependent on resources derived from coral reefs for their wellbeing. They also support between one and three million species, including approximately 25% of all marine fish species.

Coral reefs face multiple threats including from overfishing, pollution from land-based sources, dynamiting of reefs, disease outbreaks, “bleaching” from warmer sea temperatures as a result of climate change, and ocean acidification linked to higher concentrations of dissolved carbon dioxide as a consequence of human-induced atmospheric emissions [See Box 12].

In the Indo-Pacific region, where the vast majority of corals occur, living coral cover fell rapidly from an estimated 47.7% of reef areas in 1980 to 26.5% in 1989, an average loss of 2.3% per year. Between 1990 and 2004 it remained relatively stable on many monitored reefs, averaging 31.4%. An indication of the long-term decline of Indo-Pacific reefs is a drastic reduction in the proportion of reefs with at least half of their area covered by living coral – it fell from nearly two-thirds in the early 1980s to just four per cent in 2004.

Living coral cover in Caribbean reefs dropped by nearly half (from 38.2% to 20.8% living coral cover) between 1972 and 1982, with a decline of almost one-quarter (24.9%) occurring in a single year, 1981, a collapse presumed to be linked

with the outbreak of “white-band” coral disease and the impacts of Hurricane Allen in Jamaica. The overall decline of Caribbean reefs in the 1970s and early 80s has been followed by a period of stable living coral cover, with declines in some areas being roughly balanced by recovery in others. As in the Indo-Pacific region, there is no sign of long-term recovery to earlier levels of coral cover at the regional scale. It is also worth noting that recovering coral communities appear to produce more simplified reef structures, suggesting a decline in their biodiversity, as more complex structures tend to harbour a greater variety of species.

There are increasing grounds for concern about the condition and trends of biodiversity in deep-water habitats, although data are still scarce.

The condition of deep-water habitats such as sea mounts and cold-water corals has started to cause concern, as awareness increases of the impacts of modern fishing technology, especially bottom-trawling, on previously inaccessible ecosystems. Bottom-trawling and use of other mobile fishing gear can have an impact on seabed habitats equivalent to the clear-cutting of



BOX 12 The Great Barrier Reef – a struggle for ecosystem resilience



Although it is among the healthiest and best-protected coral reef systems in the world, Australia’s Great Barrier Reef has shown significant signs of decline and decreased resilience. The ecosystem continues to be exposed to increased levels of sediments, nutrients and pesticides, which are having significant effects inshore close to developed coasts, such as causing die-backs of mangroves and increasing algae on coral reefs.

There are no records of extinctions, but some species, such as dugongs, marine turtles, seabirds, black teatfish and some sharks, have declined significantly. Disease in corals and pest outbreaks of crown-of-thorns starfish and cyanobacteria appear to be becoming more frequent and more serious. Coral reef habitats are gradually declining, especially inshore as a result of poor water quality and the compounding effects of climate change. Coral bleaching resulting from increasing sea temperature and lower rates of calcification in skeleton-building organisms, such as corals, because of ocean acidification, are already evident.

While significant improvements have been made in reducing the impacts of fishing in the Great Barrier Reef, such as bycatch reduction devices, effort controls and closures, important risks to the ecosystem remain from the targeting of predators, the death of incidentally caught species of conservation concern, illegal fishing and poaching. The effects of losing predators, such as sharks and coral trout, as well further reducing populations of herbivores, such as the threatened dugong, are largely unknown but have the potential to alter food web interrelationships and reduce resilience across the ecosystem.

Even with the recent management initiatives to improve resilience, the overall outlook for the Great Barrier Reef is poor and catastrophic damage to the ecosystem may not be averted. Further building the resilience of the Great Barrier Reef by improving water quality, reducing the loss of coastal habitats and increasing knowledge about fishing and its effects, will give it the best chance of adapting to and recovering from the serious threats ahead, especially those related to climate change.

rainforests. Species from the deep ocean have become increasingly targeted as more accessible fish stocks become depleted and more strictly regulated. For example preliminary estimates suggest that between 30-50 % of the cold-water coral reefs in the Exclusive Economic Zone of Norway (that is, within 200 nautical miles of the Norwegian coast) have been impacted or damaged by bottom trawling. Other documented cases of damage caused by reef trawling have been observed in the Faroe Islands, Denmark and Iceland. All three countries have now closed some coral areas to trawling.

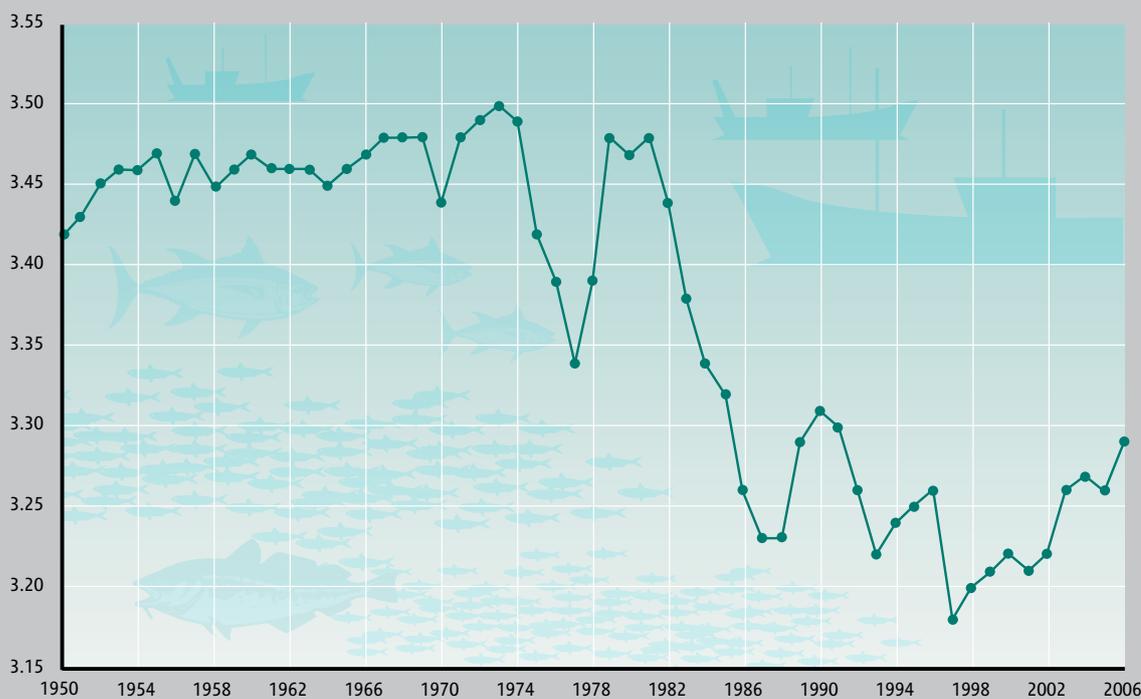
Deep-water habitats are considered especially vulnerable because species of the deep ocean tend to be slow-growing and long-lived. Cold-water corals are also considered in some studies to be particularly susceptible to impacts from ocean acidification, as the combination of cold and acidity presents a double handicap in the formation of calcified structures. However, knowledge of these systems is still very limited, and data on their global status is not yet available.

About 80 percent of the world marine fish stocks for which assessment information is available are fully exploited or overexploited.

Fish stocks assessed since 1977 have experienced an 11% decline in total biomass globally, with considerable regional variation. The average maximum size of fish caught declined by 22% since 1959 globally for all assessed communities. There is also an increasing trend of stock collapses over time, with 14% of assessed stocks collapsed in 2007.

In some ocean fisheries, larger predators have been caught preferentially in such numbers that their stocks do not recover, and there has been a tendency for catches to become dominated by smaller fish and invertebrates, a phenomenon known as “fishing down the food web”. In the long term, this compromises the capacity of marine ecosystems to provide for the needs of human communities.

FIGURE 12 China's Marine Trophic Index



Since the mid 1990s, China's Marine Trophic Index has shown signs of an increase. This follows a steep decline during the 1980s and early 1990s, resulting from overfishing. The figures suggest that although the marine food web off China may be recovering to some extent, it has not returned to its former condition.

Source: Chinese Ministry of Environmental Protection

Decades of catch records enable trends to be recorded in the average position of caught fish in the food web (the Marine Trophic Index), and thus to monitor the ecological integrity of marine ecosystems, over time [See Figure 12]. Despite the intense pressure on fish stocks, the Index has shown an increase of 3% globally since 1970. However there is substantial regional variation in the Marine Trophic Index, with declines being recorded since 1970 in half of the marine areas with data, including in the world's coastal areas and the North Atlantic and in the Southeast Pacific, Southeast Atlantic and Antarctic Indian Oceans. The largest proportional increases are in the Mediterranean and Black Seas, West Central Pacific and Southwest Pacific. Although these increases may indicate a recovery of higher predator species, they are more likely a consequence of fishing fleets expanding their areas of activity, thus encountering fish stocks in which larger predators have not yet been removed in such numbers.

While the extent of marine protected areas has grown significantly, a small proportion (less than a fifth) of marine ecoregions meet the target of having at least 10% of their area protected.

Protection of marine and coastal areas still lags far behind the terrestrial protected area network, although it is growing rapidly. Marine Protected Areas (MPAs) cover approximately half of one per cent of the total ocean area, and 5.9 per cent of territorial seas (to 12 nautical miles offshore). The open ocean is virtually unrepresented in the protected area network reflecting the difficulty of establishing MPAs on the high seas outside exclusive economic zones. Of 232 marine ecoregions, only 18% meet the target for protected area coverage of at least 10%, while half have less than 1% protection.

In various coastal and island regions, the use of community-based protected areas, in which local and indigenous peoples are given a stake in conservation of marine resources, are becoming increasingly widespread, and have shown promising results [See Box 13].

BOX 13 Locally managed marine areas (LMMAs)

In the past decade, more than 12,000 square kilometres in the South Pacific have been brought under a community-based system of marine resource management known as Locally-Managed Marine Areas.

The initiative involves 500 communities in 15 Pacific Island States. It has helped achieve widespread livelihood and conservation objectives based on traditional knowledge, customary tenure and governance, combined with local awareness of the need for action and likely benefits. These benefits includes recovery of natural resources, food security, improved governance, access to information and services, health benefits, improved security of tenure, cultural recovery, and community organization

Results of LMMA implementation in Fiji since 1997 have included: a 20-fold increase in clam density in the *tabu* areas where fishing is banned; an average of 200-300% increase in harvest in adjacent areas; a tripling of fish catches; and 35-45% increase in household income.





BOX 14 What is at stake?

Some estimated values of marine and coastal biodiversity



- ❖ The world's fisheries employ approximately 200 million people, provide about 16% of the protein consumed worldwide and have a value estimated at US\$ 82 billion.



- ❖ The value of the ecosystem services provided by coral reefs ranges from more than US\$ 18 million per square kilometer per year for natural hazard management, up to US\$ 100 million for tourism, more than US\$ 5 million for genetic material and bioprospecting and up to US\$ 331,800 for fisheries.



- ❖ The annual economic median value of fisheries supported by mangrove habitats in the Gulf of California has been estimated at US\$ 37,500 per hectare of mangrove fringe. The value of mangroves as coastal protection may be as much as US\$ 300,000 per kilometre of coastline.



- ❖ In the ejido (communally owned land) of Mexcaltitan, Nayarit, Mexico, the direct and indirect value of mangroves contribute to 56% of the ejido's annual wealth increase.