

# Mangroves and estuaries

**M**ANGROVES protect coastlines by absorbing the force of storms, and provide sufficient nutrients to nurture most of the world's marine life. Many have been lost, largely through conversion to rice paddies and shrimp farms, and with coastal regions set to double their human populations over the next 25 years, coastal ecosystems such as mangroves, estuaries, mud flats and seagrass beds are coming under increasing threat.

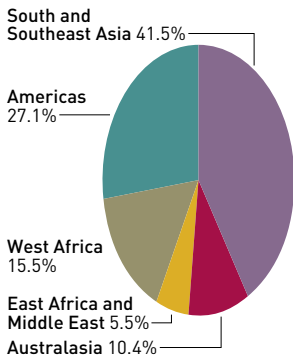
Mangroves are forests of salt-tolerant trees and shrubs that grow in the shallow tidal waters of estuaries and coastal areas in tropical regions. They require slow currents, no frost and plenty of fine sediment in which to set their roots. Their muddy waters, rich in nutrients from decaying leaves and wood, are home to sponges, worms, crustaceans, molluscs and algae, and provide shelter for marine mammals, snakes and crocodiles. They act as fish nurseries and help feed life further out to sea. Queensland's mangroves, for instance, do much to sustain the Great Barrier Reef, the world's largest coral reef system. Mangroves are also strongly correlated with the presence of shoals of shrimp further offshore.

Mangroves extend over 18 million hectares worldwide, covering a quarter of the world's tropical coastline<sup>1</sup>. They dominate the river deltas and tidal creeks of Southeast Asia from Thailand, Burma and Vietnam through Malaysia to Indonesia, with more than 5 million hectares around the thinly populated islands of New Guinea and Borneo alone<sup>2</sup>. The largest single system is the 570 000 hectares of the Sundarbans of Bangladesh, which harbor the Bengal tiger and sustain some 300 000 people.

Mangroves have many uses, providing large quantities of food and fuel, building materials and medicines. One hectare of mangroves in the Philippines can yield 400 kilos of fish, shrimps, crabmeat, molluscs and sea cucumbers annually, and help feed a further 400 kilos of fish and 75 kilos of shrimps that mature elsewhere<sup>3</sup>. The majority of the world's marine species, including most fish catches, depend on coastal wetlands such as mangroves for part of their life cycle. The seedlings of the main tree species, *Rhizophora*, cure a sore mouth and are said to have aphrodisiac powers. Filipinos use *Nypa* foliage to thatch roofs, while its fermented sap produces an annual 10 000 liters of alcohol per hectare of mangroves<sup>4</sup>.

But mangroves are nonetheless under grave threat. Their many communal benefits are no match for the quick cash profits that can be made from chopping them down for timber for firewood, draining them for urban development and farming, or converting them into salt pans and brackish shrimp ponds<sup>5</sup>. Most Caribbean and South Pacific mangroves have disappeared, while India, West Africa and Southeast Asia have all lost half their mangroves<sup>6</sup>. Growing population density is a major factor. Most of the Philippine mangroves that survive are on the least populated island of Mindanao, while the heavily populated Indonesian islands of Java and Bali have lost almost all theirs. But the increasing international trade in timber and shrimps has also been critical.

**MANGROVES OF THE WORLD, MID-1990s**  
By regional share



Total mangrove area:  
18 107 700 hectares

Source: ISME.

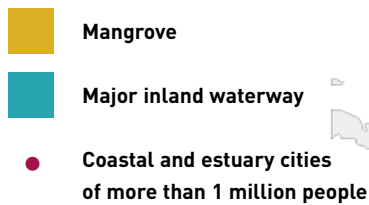
**THE WORLD'S MAJOR SHIPPING PORTS, 1997**

Port	Approximate shipping volume Gross tons
Singapore	768 000 000
Rotterdam	315 500 000
Kaohsiung	310 038 615
Chiba	173 600 000
Hong Kong	169 229 000
Nagoya	143 000 000
Antwerp	120 000 000
Yokohama	117 800 000
Hamburg	76 000 000
Long Beach	60 000 000
Los Angeles	60 000 000
Busan	46 500 000
Kobe	41 910 796
South Louisiana	33 000 000
Ulsan	31 000 000
Dubai Ports	28 000 000
Shanghai	3 600*

\*Number of vessels

Source: ISEL; Fairplay.

**MANGROVE AREAS AND COASTAL AND ESTUARY CITIES, LATE 1990s**



Mangroves are only able to grow in coastal areas such as estuaries that are free from wave action, making them particularly vulnerable to transformation by human populations, who favor similar sites for development.

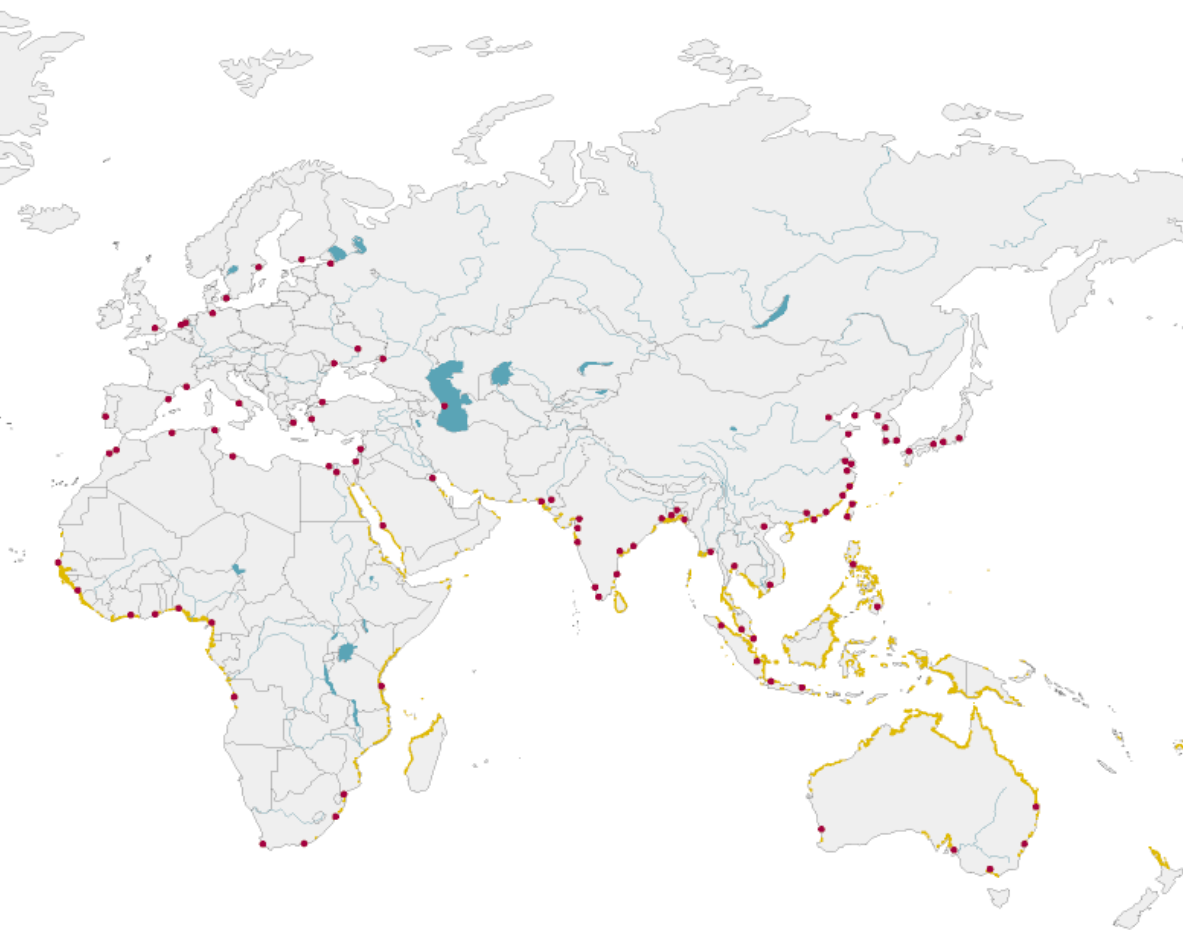


**HUMAN ACTIONS LEADING TO COASTAL DEGRADATION**

Cause of degradation	Estuaries	Mangroves	Open coasts
Drainage for agriculture, forestry and mosquito control	●	+	●
Dredging and channelization for navigation and flood protection	●	●	○
Filling for solid waste disposal, roads and commercial, industrial or residential development	●	●	+
Conversion for aquaculture	●	●	●
Construction of dykes, dams and seawalls for flood and storm control, water supply and irrigation	●	●	●
Discharge of pesticides, herbicides, domestic and industrial waste, agricultural runoff and sediment	●	●	●
Mining of wetlands for peat, coal, gravel, phosphate and other materials	+	○	+
Logging and shifting cultivation	+	●	○
Fire	+	+	○
Sediment diversion by dams, deep channels and other structures	●	●	●
Hydrological alteration by canals, roads and other structures	●	●	●
Subsidence due to extraction of groundwater, oil, gas and other minerals	●	○	+

● Common and important cause of degradation + Present but not a major cause ○ Absent or exceptional

Source: UNEP.



Source: UNEP-WCMC; UNPD.

**SOME MANGROVE LOSSES**

- Thailand:** 185 000 hectares between 1960 and 1991, to shrimp ponds
- Malaysia:** 235 000 hectares between 1980 and 1990, to shrimp ponds and clearance for agriculture
- Indonesia:** 269 000 hectares between 1960 and 1990, to shrimp ponds
- Vietnam:** 104 000 hectares between 1960 and 1974, to US Army defoliants
- Philippines:** 170 000 hectares between 1967 and 1976, largely to shrimp ponds
- Bangladesh (Chokoria):** 74 000 hectares since 1975, largely to shrimp ponds
- Guatemala:** 9 500 hectares between 1965 and 1984, largely to shrimp ponds and salt farming

Source: Choudhury; ISME.

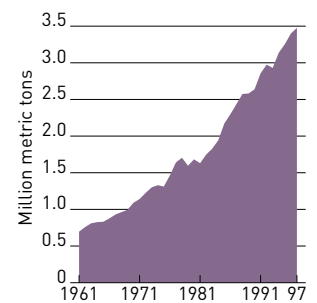
**COUNTRIES WITH LARGE AREAS OF MANGROVE**

	Mangrove area Square kilometers	As % of total land area	As % of total forest area 1995	Population density per square kilometer 1995	GDP per capita US\$ 1995
Indonesia	42 550	2.23	3.88	109.1	1 003
Brazil	13 400	0.16	0.24	19.1	4 327
Australia	11 500	0.15	2.81	2.4	19 522
Nigeria	10 515	1.14	7.63	122.7	362
Cuba	7 848	7.07	42.60	100.5	id
India	6 700	0.20	1.03	314.7	349
Malaysia	6 424	1.95	4.15	61.3	4 236
Bangladesh	5 767	4.00	57.10	925.2	246
Papua New Guinea	5 399	1.17	1.46	9.5	1 139
Mexico	5 315	0.27	0.96	49.1	2 743

**Note:** The mangroves in these countries represent 64% of world mangroves.

Source: ISME; WRI.

**RISING SHRIMP AND PRAWN PRODUCTION**



Source: FAO.

## THE REVIVAL OF CHESAPEAKE BAY

### Phosphorus content



1984-87



1997-2000



High

Low

Source: CBP.

Following the initiative to rehabilitate Chesapeake Bay in the United States, there has been a marked decrease in the levels of phosphorus found in the waters of the bay and surrounding areas. Levels of nitrogen and suspended particulates have not declined to the same degree. However, there has been an improvement in the health of wildlife in and around the bay, even while the human populations have increased considerably. Future population growth and sprawl represent the biggest challenges to the health of Chesapeake Bay.

The fate of mangroves shows in stark relief the crisis facing the world's coastal regions, which have the fastest rates of both urbanization and population growth. Half the world's population, some 3 billion people, live within 200 kilometers of the coast. By 2025 that figure may double, rising to three quarters, or 6 billion people<sup>7</sup>.

Thirteen of the world's 16 largest cities are on the coast<sup>8</sup>, as are most of the fastest growing Asian cities: Bangkok, Jakarta, Karachi, Manila, Mumbai and Shanghai. An estimated 80 million Chinese have moved to coastal cities in recent years; in the United States people are moving to the coast at the rate of 3 600 a day and the five fastest growing states are all coastal; in Australia, 90 percent of all building activity is in the coastal zone.

Coasts offer fertile soils for tilling, flat land for urban development and sites for trading ports. A detailed analysis by the World Resources Institute<sup>9</sup> found 51 percent of the world's coastlines under "moderate" or "high" threat from development activities. The study found a strong correlation between mangrove loss and the growth of cities and ports, and a moderate relationship with population density. Development for tourism was found to be a major threat to coastal ecosystems in the Caribbean.

People also bring pollution. The most serious sources of coastal pollution are nutrients from farming, land clearance and sewage disposal – a problem often made worse by the loss of natural filters such as mangroves. One result of the consequent overfertilization of coastal waters is "red tides" of toxic algae, such as the explosive growth that covered much of the South China coast, including all of Hong Kong, in 1998, decimating fish farms and causing seafood poisoning<sup>10</sup>. Other outbreaks of toxic algae are thought to have caused mass mortalities of sea mammals, such as the 100 critically endangered Mediterranean monk seals found dead on the Mauritanian coast in 1997<sup>11</sup>.

The world's seagrasses are also under threat because of urban pollution and the invasion of alien species. In recent years Australia has lost 450 square kilometers of seagrasses and the United States 900 square kilometers<sup>12</sup>. Meanwhile the habitat of Mediterranean seagrasses along the French and Italian Riviera has been invaded by tropical algae, *Caulerpa taxifolia*, thought to have escaped from the Monaco Oceanographic Observatory<sup>13</sup>.

Many governments find it hard to secure communal benefits from the protection of habitats such as coastal wetlands in the face of the private profit motive. To be successful requires complex coastal management programs. The United States has begun a long process of rehabilitating its largest brackish estuary, Chesapeake Bay, by cutting pollution, including from nutrients in the surrounding catchment, and restricting coastal development. Popular local support is vital to such programs. Ecuador has discouraged the further destruction of its mangroves by giving shrimp farmers incentives to restore them<sup>14</sup>. Bangladesh employs villagers in its Sundarbans reserve in a program of mangrove planting on coastal mudflats. More than 100 000 hectares have been planted so far.

### STORM PROTECTION

Mangroves protect shorelines from devastation by storms. The trees both shield the land from wind and trap sediment in their roots, maintaining a shallow slope on the seabed that absorbs the energy of tidal surges. Their loss can prove disastrous. In the Indian state of Orissa, where the low-lying coastline has been stripped of mangroves to make way for tiger-prawn farms, a cyclone came ashore in 1999, drowning an estimated 10 000 people<sup>15</sup>.