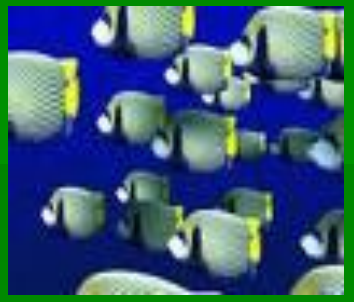
MARINE BIODIVERSITY HOTSPOTS



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BIODIVERSITY HOTSPOTS

Regions that harbor a great diversity of endemic species and, at the same time, have been significantly impacted and altered by human activities.

The idea of defining hotspots is generally credited to the ecologist Norman Myers, who suggested that global conservation efforts should be concentrated in areas where there were high numbers of endemic species and the threat to those species was high.

Biodiversity hotspots

The areas that are compared to describe hotspots may be restricted by region or habitat.

Examples include marine biodiversity hotspot, global biodiversity hotspot, estuarine biodiversity hotspot, European marine biodiversity hotspot.

GLOBAL MARINE HOTSPOT ASSESSMENTS

- The hotspots approach advocated by Myers has been applied to coral reefs.
- Distribution records of 3235 species of fish, coral, snails and lobsters were used to identify 18 centres of endemism.
- A total of ten of these centres were defined as hotspots as they were at a greater threat of extinction. The ten hotspots were South Japan, the Gulf of Guinea, the North Indian Ocean, Eastern South Africa, Cape Verde Islands, West Caribbean, Red Sea, Philippines, South Mascarene Islands and the Sunda Islands.

GLOBAL MARINE HOTSPOT ASSESSMENTS

- Open ocean hotspots have been defined using data associated with long line fisheries.
- This analysis identified areas of high species richness in warmer oxygenated water – particularly in the south eastern Pacific Ocean, south of the Hawaiian Islands, east of Sri Lanka and off the eastern coasts of Australia and the U.S.A.
- The development of global marine hotspot assessments has been limited by the coverage of data.
- Programmes such as the Census of Marine Life are intended to address such gaps. With the growth of marine biodiversity infrastructure, there is likely to be a period of rapid expansion in the understanding of marine biodiversity hotspots.

REGIONAL AND LOCAL HOTSPOTS

Hotspots at regional scales may be used to guide conservation policy and recommendations.

The criteria for some, although not all, marine protected area selection processes include a measure of the relative richness, rarity and/or threat.

The finer scale of spatial analysis for regional studies places further demands on the available data. There are no accepted criteria for deciding how much of a deviation from the average biodiversity for a region is needed for an area to qualify as a hotspot.

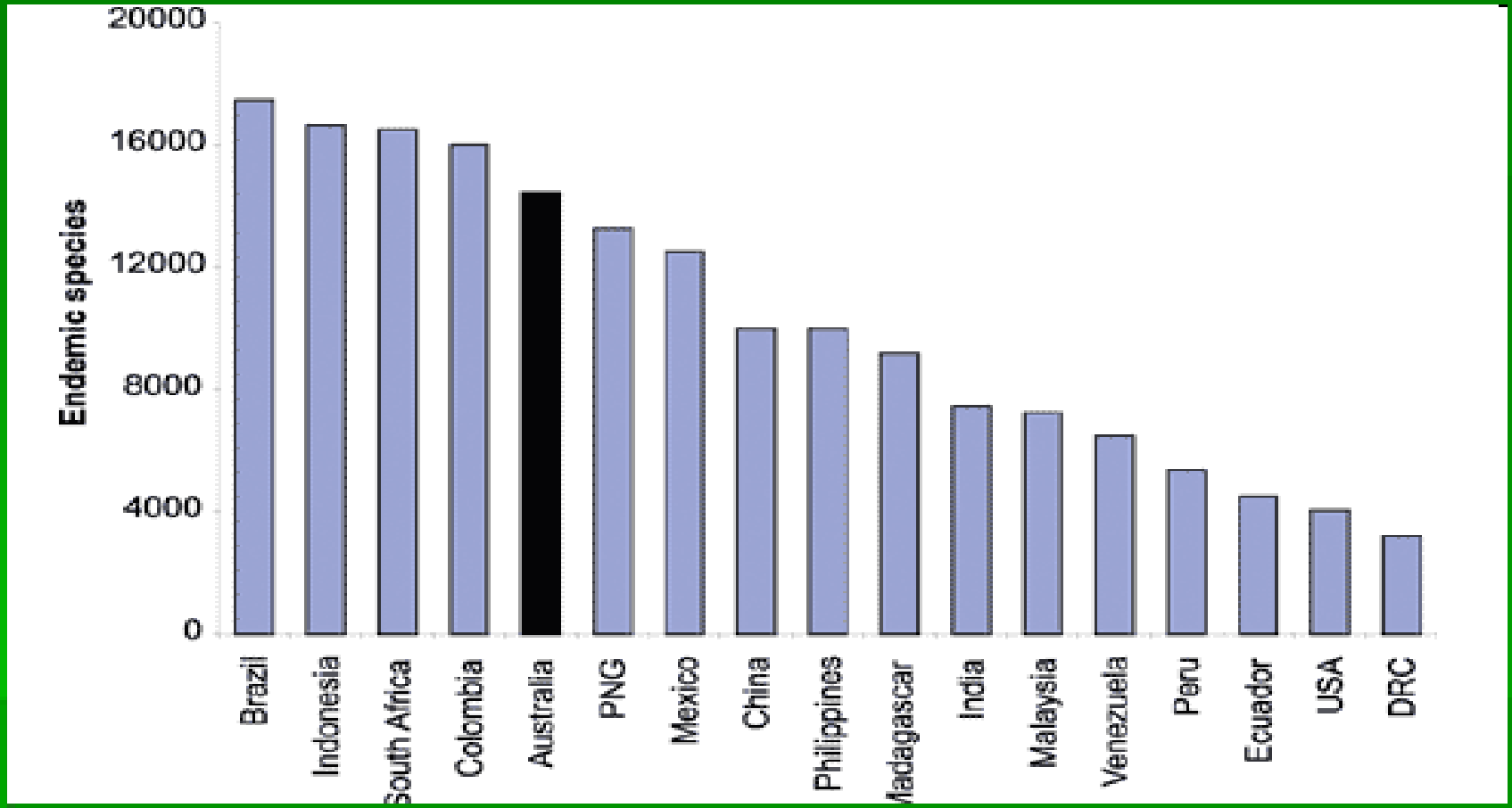
MEGADIVERSE COUNTRIES

The concept of megadiversity is based on the total number of species in a country and the degree of endemism at the species level and at higher taxonomic levels.

The World Conservation Monitoring Centre recognised 17 megadiverse countries in July 2000 including Australia, Brazil, China, Colombia, Democratic Republic of the Congo (DRC) (formerly Zaire), Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, the Philippines, South Africa, the United States of America (USA) and Venezuela.

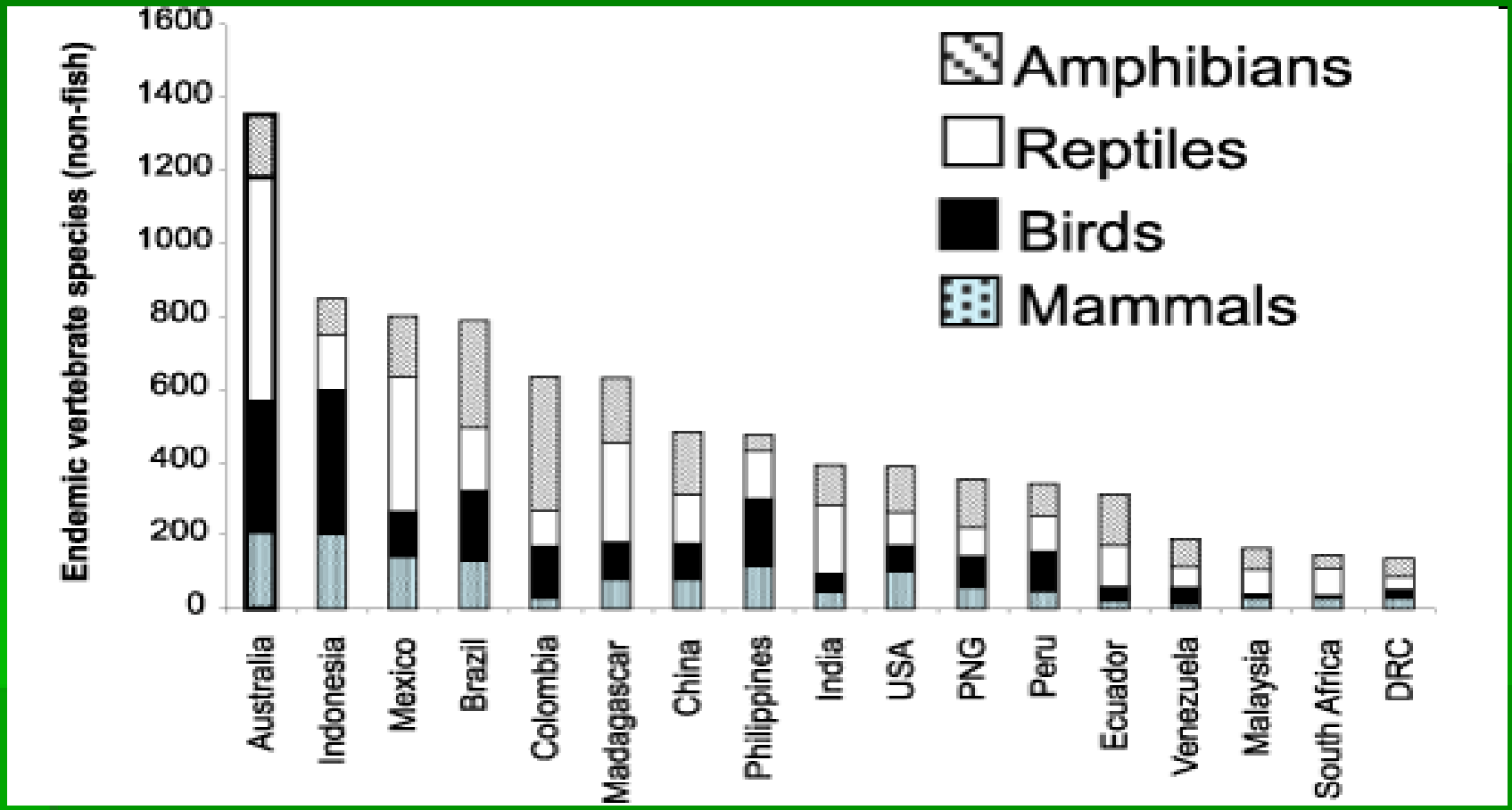
Together, these 17 countries harbour more than 70% of the earth's species.

MEGADIVERSE COUNTRIES



Number of endemic vascular plant species in 17 megadiverse countries India has the eleventh highest number of species in this group. PNG, Papua New Guinea; DRC, Democratic Republic of the Congo.

ENDEMIC SPECIES



Number of endemic non-fish vertebrate species in 17 mega-diverse countries illustrating that Australia has the highest level of endemism for this group of species. PNG, Papua New Guinea; DRC, Democratic Republic of the Congo.

BAHIA COASTAL FORESTS

The Bahia coastal forests occupy a belt approximately 150 km (90 miles) wide along the Atlantic coast of eastern Brazil, in the states of Bahia and Espirito Santo. The Itapicuru River forms the northern boundary of the ecoregion, which extends south to near the Itapemirim River. The ecoregion is bounded on the east by the Atlantic Ocean and the enclaves of the Atlantic Coast restingas forests and Bahia mangroves. To the west, the forests transition to the drier Bahia interior forests.

CARIBBEAN ISLAND

The **Caribbean** is a region consisting of the Caribbean Sea, its islands (most of which enclose the sea), and the surrounding coasts. The region is located southeast of the Gulf of Mexico and Northern America, east of Central America, and to the north of South America.

The Caribbean islands are classified as one of Conservation International's Biodiversity hotspots because they support exceptionally diverse ecosystems

These ecosystems have been devastated by deforestation and human encroachment. The hotspot contains dozens of highly threatened species, ranging from birds, to mammals and reptiles. Popular examples include the Puerto Rican Amazon, two species of solenodon (giant shrews) in Cuba and Haiti, and the Cuban crocodile.

COASTAL FORESTS OF EASTERN AFRICA

- The **Coastal forests of eastern Africa** is a tropical moist forest region along the east coast of Africa.

- The forests extend in all narrow band along the coast of the Indian Ocean from southern Somalia in the north, through coastal Kenya and Tanzania to the mouth of the Limpopo River in southern Mozambique.

MEDITERRANEAN BASIN

The **Mediterranean Basin** refers to the lands around the Mediterranean Sea that have a Mediterranean climate, with mild, rainy winters and hot, dry summers, which supports characteristic Mediterranean forest.

The Mediterranean basin together with the nearby Atlantic coast, the Black Sea coast of northeasten Anatolia, the southern coast of Crimea between Sevastopol and Feodosia and the Black Sea coast between Anapa and Tuapse in Russia forms the *Mediterranean Floristic Region.* The Mediterranean Region was first proposed by German botanist August Grisebach in the late 19th century.

OCEANIA

Oceania is one of the WWF ecozones, and unique in not including any continental and mass.

The ecozone includes the Pacific Ocean islands of Micronesia, the Fijian islands, and most of Polynesia (with the exception of New Zealand).

Oceania is the smallest in land area of any of the ecozones.

SUNDALAND

Sundaland is a region of Southeastern Asia that comprises the Malay Peninsula and Maritime Southeast Asia islands of Sumatra, Java, Borneo, and surrounding smaller islands.

The eastern boundary of Sundaland is the identified by Alfred Russel Wallace, which marks the eastern boundary of the Asia's land mammal fauna, and is the boundary of the Indomalaya and Australasia ecozones.

The islands east of the Wallace line are known as Wallacea and are considered part of Australasia.

THE MAJOR REEF AREAS
(Marine Biodiversity Hotspots)

- Oceans cover 71 percent of earth's surface. Oceans have long been considered limitless places where human activities have little or no impact.
- But the coral reefs, the richest of the tropical marine habitats, are at risk of disappearing at an incredibly fast rate!
- Worldwide, already 25 percent of coral reefs have been destroyed or badly degraded. Some scientist reckon, that by 2020 up to 70 percent might be permanently lost.

THE MAJOR REEF AREAS
(Marine Biodiversity Hotspots)

- In 2002 researchers identified global priority areas for coral reef conservation and prepared a list with the world's top 10 coral reef hotspots.
- These are areas rich in marine species which are found only in small area. Therefore they are highly vulnerable to extinction.
- These 10 hotspots contain just 24 percent of the world's coral reefs, or 0.017 percent of the oceans, but claim 34 percent of restricted-range species.
- An interesting fast is, that 8 of the 10 coral reef hotspots are adjacent to a terrestrial hotspot. Those are regions of the world that harbor the highest concentrations of species on land and are also at the greatest risk.

THE MAJOR REEF AREAS
(Marine Biodiversity Hotspots)

In addition to the correlation with terrestrial biodiversity hotspots, the paper notes that tropical reef ecosystems include "wilderness" areas, which remain far less impacted by people, are rich in species, and relative to degraded areas, still contain abundant populations of reef species that have already but disappeared from overexploited reefs.

GLOBAL HOTSPOTS (CORAL REEFS)

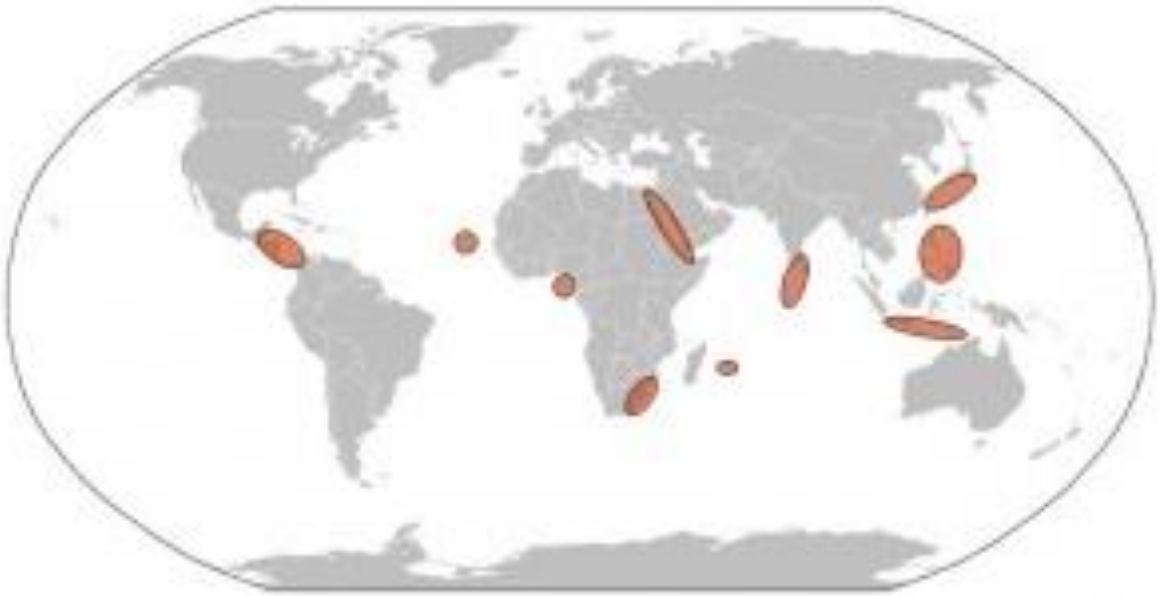
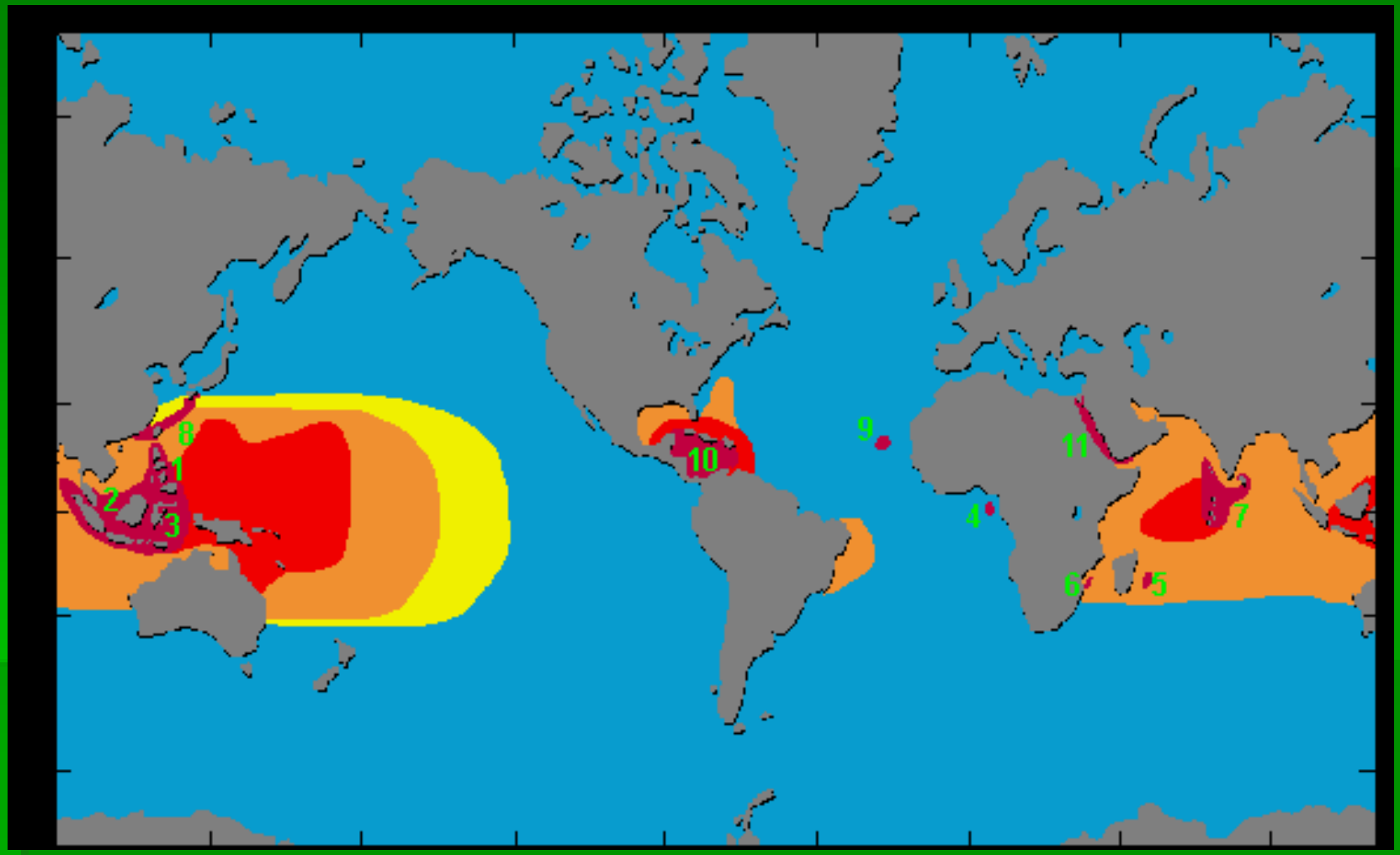


Figure 1 Approximate locations of 10 marine biodiversity hotspots as centres of reef fish, coral, snail, and lobster endemism also facing relatively high threats (Roberts et al. 2002). Areas are (from West to East) West Caribbean, Cape Verde Islands, Gulf of Guinea, Eastern South Africa, Red Sea, South Mascarene Islands, North Indian Ocean, Sunda Islands, Philippines, South Japan.

Why 11 marine hotspots?

- In 2002 the global environmental group Conservation International presented a strategy to concentrate conservation efforts on these hotspots.
- This strategy prioritizes and targets conservation investments where they have the greatest impact.
- They name 25 Biodiversity Hotspots (on land and in the sea) and divided the so called Coral Triangle (Indonesia, Philippines, Papua New Guinea) in three different regions (Philippines, Sundaland, Wallacea). So therefore added another hotspot to the list from the Centers for Applied Biodiversity Science (CABS) resulting in 11 hotspots.

MARINE BIODIVERSITY HOTSPOTS REGIONS



yellow = not very rich in marine species / orange = rich / red = very rich / dark red = regions with a lot of endemic species (= hotspots)

PHILIPPINES

- The Philippines are ecologically unique in as far that there are a lot of small regions and areas (such as an island) that are highly diverse.

- Major threats are destructive fishing methods using explosives and poison (cyanid fishing for the aquarium trade), excessive fishing, pollution runoff from logging, agriculture and urban development.

- This is one of the most threatened hotspots, due to its population density.

SUNDALAND

- The **Sundaland** hotspot encompasses some 1'600'000 km2 and covers the western half of the Indonesian archipelago (Bali, Java, Sumatra, Borneo), Malaysia and a small part of Thailand.

- It is part of the so called **Coral Triangle** which is probably the most diverse coastal area on the planet having a richness of marine species and a large occurrence of endemism.

- Major threats are pollution from land-based sources, intensive destructive fishing (dynamite) and a growing live reef fish trade (for the aquarium trade).

WALLACEA

- The Wallacea hotspot encompasses some 346'782 km2 and covers Nusa Tenggara (Lombok, Sumbawa, Komodo, Flores, Sumba, Savu, Roti and Timor), the Mollucas and Sulawesi.

- Wallacea is divided from Sundaland by the Wallace;s Line. Major threats are pollution from land-based sources, sediment pollution from logging, intensive destructive fishing (dynamite) and live reef fish trade (for the aquarium trade).

GULF OF GUINEA

This hotspot encompasses the four islands (Annobón, Bioco, São Tomé and Príncipe) of the Gulf of Guinea, off the West African coast.

The exact area of reef is unknown, but is likely to be less than 200 km^2. There are rivers nearby, so the water is not very salty.

Major threats from coastal development, sediment pollution from logging, over-fishing and a proposed coral harvesting business.

SOUTHERN MASCARENE ISLANDS

This hotspot encompasses approximately 1'000 km^2 of reef surrounding the islands of Mauritius, La Reunion and Rodriguez in the southern Indian Ocean.

Major threats are the rapidly growing human population, pollution from intensive sugar cane production, coastal and agricultural development, and over-fishing.

EASTERN SOUTH AFRICA

This hotspot lies adjacent to Cape Floristic and encompasses less than 200 km2. Major threats are land-based sources of pollution, fishing and development of tourism.

NORTH INDIAN OCEAN

This hotspot encompasses the Maldives, Chagos islands and much of the Lakshadweep and Lakkadives archipelagoes, as well as Sri Lanka, a total of 10,000 km2.

Global warming in 1998 increased the sea surface temperatures and resulted in severe coral bleaching. Global climate change continues to pose a threat, as do coral mining, over-fishing and ornamental fish collection.

SOUTHERN JAPAN, TAIWAN AND SOUTHERN CHINA

Over 3,000 km^2 of reefs extending from Kyushu in Japan, through Taiwan to the coast of southern China.

Major threats are shoreline development (proposed airport) and conversion for agriculture and aquaculture, rapidly growing human population and also global climate change, sea warming, and plagues of coral-eating Crown-of-Thorns starfish.

CAPE VERDE ISLANDS

Approximately 200 km^2 in the mid-Atlantic off the West African coast.

Major threats are coastal development, pollution from land clearing and agriculture, and over-fishing.

WESTERN CARIBBEAN

This hotspot encompasses the Caribbean islands and coastal reefs from the Mexican Yucatan Peninsula to Colombia, more than 4'000 km2 of reefs.

Major threats are epidemic diseases and coral bleaching resulting from global warming and coastal development for tourism.

THE RED SEA AND GULF OF ADEN

The Red Sea and Gulf of Aden hotspot extends for 2'500 km from north to south, including the Gulfs of Aqaba and Suez.

Major threats are coastal and industrial developments, tourism and oil spills from tankers. The western and southern coast are less threatened.

INDIAN MARINE BIODIVERSITY HOTSPOTS

GULF OF MANNAR

- The first marine biosphere reserve in all of South and Southeast Asia is located on the southeastern tip of India in the state of Tamil Nadu, in the Indo-Pacific region.
- The GOMBR is an international priority site for many reasons – it's biophysical and ecological uniqueness, economic, social, cultural, scientific importance, national and global significance.
- The Biosphere reserve extends from Rameswaram Island to Tuticorin in a NE-SW direction to a distance of 140 km.
- There are 21 islands running almost parallel to the coastline of Gulf of Mannar with three distinct Marine ecosystems namely corals, seagrass and mangroves.
- The islands in the Gulf of Mannar are classified into 4 major groups - Tuticorin, Mandapam, Keezhakarai and Vembar.

GULF OF MANNAR

- Around 3,600 species of fauna and flora have been identified in the Gulf of Mannar area, which comprises of 3 different ecosystems - Sea grass, Mangrove and Coral Reef Ecosystem.

- 17 species of mangrove occur within the reserve and act as an important nursery of habitats.

- The shallow waters in the area have the highest concentration of sea grass species along India's over 8,000 km coastline. 11 species of sea grass recorded in India are found in the reserve.

GULF OF MANNAR

- The island's surrounding shallow waters harbours 3 species of seagrass that are found nowhere else in India. These same shallow waters are also known to have at least 147 species of marine algae *(seaweed)*.

- These support complex ecological communities and provide feeding grounds for many species, including the globally endangered marine animal, dugong. Endangered species such as whales, dolphins, sea horse and sea snakes are found in these waters as well.

GULF OF MANNAR

- Productive fringing and the patchy coral reef surrounding the Park's islands are comprised of at least 91 species of coral reef systems.
- The islands are used by 168 migratory bird species and the sandy shores of most islands provide a nesting habitat for 5 species of marine turtles.
- This region is also home to over 450 species of fish, 79 species of crustaceans, 108 species of sponges, 260 species of mollusks and 100 species of echinoderms.

GULF OF MANNAR

Krusadai Island, in Mandapam, exemplifies the biological significance of the Gulf. The fact that close to 3,600 species of plants and animals are natural inhabitants of the Gulf of Mannar make it the biologically richest coastal region in India.

ORISSA- BITHARKANIKA

- On the east coast of India lies one of the richest biodiversity regions in Southeast Asia.
- Consider this: it is bounded on the east by the Bay of Bengal and its 480 km coastline extends from the Subarnarekha River in West Bengal to the Bahuda River in Andhra Pradesh.
- It has not one but 7 major river deltas of varied sizes and shapes formed by the rivers Subarnarekha, Budhabalanga, Baitarani, Bramhani, Mahanadi, Rushikulya and Bahuda.

ORISSA- BITHARKANIKA

- This region has 5 major morphological zones - the coastal plains, the middle mountainous and highlands region, the central plateaus, the western rolling uplands and major flood plains.
- This region is Orissa - home to a high diversity of marine and reptilian life.
- The coast of Orissa forms a highly complex yet dynamic eco-system, comprising of a myriad of wetlands, deltas, mangroves, and mudflats- truly an ecologist's paradise!
- These factors make the coastline of Orissa an ideal habitat for many species like the estuarine crocodile, fresh and brackish water terrapins, dolphins, porpoises and the endangered sea turtles. There are four species of sea turtles (out of the seven in the world) found in Orissa - the Olive Ridley, the Hawksbill, the Leatherback and the Green Sea Turtle.

BITHARKANIKA

- Located in the deltaic region of Brahmani and Baitarani on the north - eastern coast of Orissa is the Bhitarkanika National Park.

- Supporting a wide variety of wetland habitats ranging from tidal rivers and creeks to riverine islands and intertidal zones, apart from coastal wetlands along the eastern boundary, it is a hot-spot of biodiversity.

- Home to the largest population of giant salt water crocodile in India and more than 215 species of avifauna, it is the second largest viable and contiguous Mangrove Eco-System in India which Harbours more than 70 species of Mangrove and its associates.

BITHARKANIKA

Bhitarkanika is also home to several mammals. Five species of marine dolphins have been recorded from the area. Notable among the other mammalian fauna of Bhitarkanika are the striped hyena, the fishing and jungle cat, smooth - coated otter, civet, Indian porcupine, wild boar, spotted deer and sambar.

BITHARKANIKA

- World over, Orissa is known for its *arribada's* – synchronized mass nesting of Olive Ridley Turtles. These turtles nest here in thousands every year during winter at three beaches: Devi, Gahirmata, and Rushikulya.
- Gahirmatha beach, which forms the eastern boundary of Bhitarkanika Wildlife Sanctuary, supports the largest known nesting beach of olive ridley sea turtles in the world.
- Nearly half a million Olive Ridleys nest every year at Gahirmatha. Besides, the coastal waters off Gahirmatha are a major mating area for the olive ridley sea turtle that migrate to this coast every winter.

PICHAVARAM

- Known for its unique mangrove ecosystem, Pichavaram is located in the northernmost part of the Cauvery delta, in the Vellar-Coleroon estuarine complex and has many islands separated by intricate water-ways.
- Covering an area of over 400 hectares, it is traversed by a large number of channels and creeks which connect the Coleroon Estuary in the South and Vellar estuary in the north.
- It consists of number of small and large islets surrounded by numerous creeks, canals and channels.
- The Pichavaram mangrove wetland consists of 3 Reserve Forests - Killai, Pichavaram and Pichavaram Extension area.

PICHAVARAM

- These mangroves are the rainforests by the sea and are comprised of taxonomically diverse, salt-tolerant tree and other plant species which thrive in inter-tidal zones of sheltered tropical shores, and estuaries.

- The shallow inter-tidal reaches that characterize these mangrove wetlands offer refuge and nursery grounds for juvenile fish, crabs, shrimps, and mollusks and are also prime nesting and migratory sites for hundreds of bird species.

PICHAVARAM

- They have been useful in treating effluents, as the plants absorb excess nitrates and phosphates thereby preventing contamination of near shore waters.
- This protective buffer zone has also minimized damage of property and losses of life from cyclones and storms.
- In regions where these coastal fringe forests have been cleared, tremendous problems of erosion and siltation have arisen, and sometimes terrible losses to human life and property have occurred due to destructive storms.
- When the tsunami struck Tamil Nadu, areas in Pichavaram and Muthupet with dense mangroves suffered fewer human casualties and less damage to property compared to areas without mangroves.

PICHAVARAM

- The biological diversity of Pichavaram is extensive and rich.
- Aquatic floral community such as seaweeds and seagrasses occur in this ecosystem.
- The mangroves are distributed in varying degrees of abundance, supporting an abundant growth of oysters, important crustaceans, several varieties of fish and specie of marine turtle, the Olive Ridley.

PICHAVARAM

- Pichavaram is also an important habitat for a variety of resident and migratory waterfowls and other birds, with over 200 species having being recorded from here.
- These Mangrove systems play home to the common otter, jackals, water snakes, water dogs and foxes as well.
- The wetlands are rich in fishery resources, including a variety of species of fish, oysters and green mussels and over 26 species of finfish, 7 species of prawns and 4 species of crabs.
- Plankton and other micro organisms, which proliferate in the mangrove and its surroundings, are eaten by fishes, prawns, crabs and mollusk larvae.

UNIQUE FEATURES OF THESE MANGROVES

- The Mangrove species ‘Rhizophora’ found here is evergreen and crucial from the biodiversity perspective. The spread of this specie in other wetlands in India, except for the Andaman and Nicobar, is a bare minimum.
- A natural hybrid of the Rhizophora species, born out of cross-pollination is endemic to this region.
- Extinct and Rare species - Two mangrove plants (*Kandelia Candel* and *Bruguiera Gymorrhiza* are otherwise extinct across the world and 1 species (*Xylocarpus granatum*), which is on the anvil of extinction, is present here.
- Among the 14 species of mangroves recorded from this region, 10 species are listed as critically endangered and 3 species as vulnerable as per IUCN’s red list.