The AREA'S RICHNESS

While there is little doubt that the Coral Triangle is the richest marine environment on the planet, the reasons for the richness are hotly debated. Is it because the richest taxonomic groups originated in the Coral Triangle and dispersed to the rest of the world? Or is it because of the overlap of flora and fauna from the West Pacific Ocean and Indian Ocean? As it turns out, the only thing that is clear is that the reasons for the area's richness are complex and no single model explains it all.

Some of the many factors that influence the diversity of the Coral Triangle are the geological history of the region, including plate tectonics and sea-level fluctuations; how species disperse and the factors that facilitate or inhibit dispersal; general biogeographic patterns and evolutionary forces.

The tropics are generally more species rich than temperate and polar areas particularly because of the constant sunlight regime and weather stability. Without a winter period, organisms can flourish year round and put more energy into specialization than into preparing for long periods with reduced sunlight. This is as true in the marine realm as it is in the forests, where light and relatively constant warm water temperatures persist throughout the year. However, coastal tropical waters are relatively nutrient poor.

The annual changes in water temperatures of the temperate and polar seas produce mixing when the surface waters cool and sink to the bottom. The displaced bottom waters, rich with dead plankton that has sank to the depths, are forced to the surface and result in huge explosions of zooplankton and fish populations. Such mixing does not happen in the tropics because the surface waters remain warm year round. The richness here is centred on the coral reefs that survive by building intricate relationships between organisms, resulting in habitats with many niches of incredible biodiversity surrounded by virtual deserts of nutrient-poor ocean.

The wide variation in habitats in the Coral Triangle also helps to explain the diversity. With so many islands, there is ample area for coral-reef growth. Some of the islands border deep-sea basins, and some border shallow continental shelves. At a local scale, large areas of coral reef like Malaysia's Semporna Archipelago and the Indonesian Spermonde Archipelago have a rich mix of reef types, with some exposed to high-energy areas facing open seas and others in sheltered bays. This leads to different species occupying these different habitats and increases the richness of the Coral Triangle.

The Coral Triangle lies at the intersection of the Indian and Pacific Oceans. It may be the richest marine environment in the world simply because of the overlap of so many different marine ecoregions.

Above: One of the two largest moray eels in the Coral Triangle, the Honeycomb Moray (*Gymnothorax favagineus*) can grow up to 3 m (3 ft).

Top: The Thornback Cowfish (*Lactoria fornasini*) may be one of the strangest looking fish on Coral Triangle reefs.

Opposite: The lagoon of Tun Sakaran Marine Park provides habitat different from reefs exposed to strong waves and currents facing the Sulawesi Sea.

Due to ocean circulation patterns and the rotation of the Earth, the western Pacific Ocean is slightly higher than the eastern Indian Ocean and there is a strong current, the Indonesian Through-flow, which diverts Pacific waters to the Indian Ocean. Currents moving out of the Coral Triangle region to the north and south bring larvae into cooler temperate waters along the coast of Australia and north to Japan. The cooler environments are less suitable for corals and reefs. Thus, coral and fish larvae are brought to the Coral Triangle from the Pacific Ocean, but when currents leave the Coral Triangle any exported organisms are unlikely to survive.

The relatively recent history of ice-age related sea-level changes is thought to have contributed to the richness. As sea levels dropped by more than 100 m (328 ft) circulation patterns changed, deep basins were isolated, and many seabeds were exposed and the newly exposed reefs died. Within those isolated basins marine species may have evolved into new species. Rivers were draining larger continental areas and the outflow became a freshwater barrier to larvae migrating along the coast, further isolating organisms that could not disperse through the less saline waters. The large continental shelf areas of the Sunda and Arafura Seas were exposed. As the glaciers melted and sea levels rose, the newly evolved species were free to mix around the Coral Triangle area and recolonize the previously exposed land – a process that is ongoing.

Above: The sea level 17,000 years ago was approximately 120 m (400 ft) lower than it is now and the Sunda and Sahul Shelves isolated parts of the Coral Triangle perhaps leading to some of its richness.