

Delineation of the Indo-Malayan Centre of Maximum Marine Biodiversity: The Coral Triangle

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The centre of the Malayan fauna is formed by the Malay Archipelago, joined by some neighbouring areas around it. Where its exact boundaries are located, we do not know. Also, there is no generally accepted designation; Indo-Australian, Indo-Malayan, and Insular Indian are other indications.

(Translation from the original German text; S. Ekman, 1935: 32).

The mechanisms giving rise to marine biodiversity in the southeast Asian region are not well-understood.

(J.A.H. Benzie, 1998: 197).

Abstract The ranges of many tropical marine species overlap in a centre of maximum marine biodiversity, which is located in the Indo-Malayan region. Because this centre includes Malaysia, the Philippines, Indonesia, and Papua New Guinea, it has been named the East Indies Triangle. Due to its dependence on the presence of coral reefs, it has recently been referred to as the Coral Triangle. Because these reefs are severely threatened by human activities, large-scale nature conservation efforts involve the establishment of a network of Marine Protected Areas (MPAs), for which it is important to know the position of this diversity hotspot. Although it is recognized where this centre is located approximately, it is unclear where its exact boundaries are. Only in a limited number of biogeographical studies, ranges and diversity centres of Indo-West Pacific (IWP) taxa have been presented. In this regard, tropical corals, marine fishes, and molluscs have received most attention. However, just for reef corals alone several different diversity centres have been proposed. The boundaries of the centre are important for reconstructing the processes that were responsible for its present shape. They may relate to the area's climatic and geological past or to the dispersal of larvae by currents in combination with ecological constraints that may prevent their settlement. Especially, in brooding organisms, without larvae or other propagules performing long-distance dispersal, isolation mechanisms may have been important for speciation and species diversity. Information on sea-level fluctuation and the past position of coastlines and data on molecular variation between and within species may help to support models that explain the present position of the centre of marine biodiversity. A detailed biogeographical study of the Fungiidae, a family of corals that disperse through larvae, is used to present a model for a diversity centre and the processes that may have caused its present position. For each species, presence-absence data were obtained from many areas in order to plot their distribution patterns. Since several species do not occur on Sunda shelf reefs, the western part of this diversity centre may have been moulded along the Sunda shelf margin since the end of the LGM (17,000–18,000 BP). Species diversity appears to be distributed unevenly among areas within this centre, which depends on habitat heterogeneity, such as cross-shelf gradients in salinity and turbidity. Eventually, the distributions of several model taxa need to be compared in a sufficiently high number of areas in order to find a more common delineation of the Coral Triangle. Many corals are widespread and have a long fossil record. Moreover, coral reefs have not always been located in their present positions. This makes it complex to find which processes have caused a present diversity maximum. Since most species are concentrated in the eastern part of the Indo-Malayan archipelago and part of the West Pacific, this may be the area where most of the youngest species have originated, but sea-level fluctuations probably have been responsible for excluding large continental shelf seas from the Coral Triangle.

1. Introduction

The presence of a marine latitudinal diversity gradient, i.e., an increase in species richness with decreasing latitude from the tropics to both polar regions, is commonly recognized (Ekman, 1934; Briggs, 1974). The circum-tropical belt of