

CORAL TRIANGLE FACTS, FIGURES, AND CALCULATIONS:

Part II: Patterns of Biodiversity and Endemism

Dec 16, 2008

CT is regarded as the **global epicenter of marine biodiversity** (Allen 2007; Hoeksema 2007, Veron 1995, 2000, Veron et al. unpubl. data), and a global priority for conservation (Allen 2000; Briggs 2005b; Hughes et al. 2002; Roberts et al. 2002; Wallace et al. 2001).

1. Reef building (zooxanthellate) corals (Veron et al. unpubl data)

- The Coral Triangle comprises the highest coral diversity in the world (Figure 1): **76% (605) of the world's coral species** (798: Figure 1). By comparison, approximately 8% of coral species (61) occur in the Caribbean.
- Highest coral diversity resides in the Bird's Head Peninsula of Indonesian Papua (within the Papua ecoregion, Table 1), which hosts 574 species (95% of CT total, and 72% of the world's total), with individual reefs supporting up to 280 species per hectare. Within the Bird's Head Peninsula, Raja Ampat is the World's coral diversity bull's eye with 553 species.
- There is a lot of internal consistency within the CT, with 66% of all CT species common to all ecoregions and 80% of all CT coral species found in the majority of ecoregions.
- The CT has 15 regionally endemic coral species, and shares 41 regional endemic species with Asia. Regional centers of endemism in the CT include the Sulu Sea and North Lesser Sunda Islands/Savu Sea in Indonesia, and Milne Bay in Papua New Guinea. Levels of coral endemism are lower in the CT than some other parts of the world (particularly the Red Sea/ Arabian Sea region).

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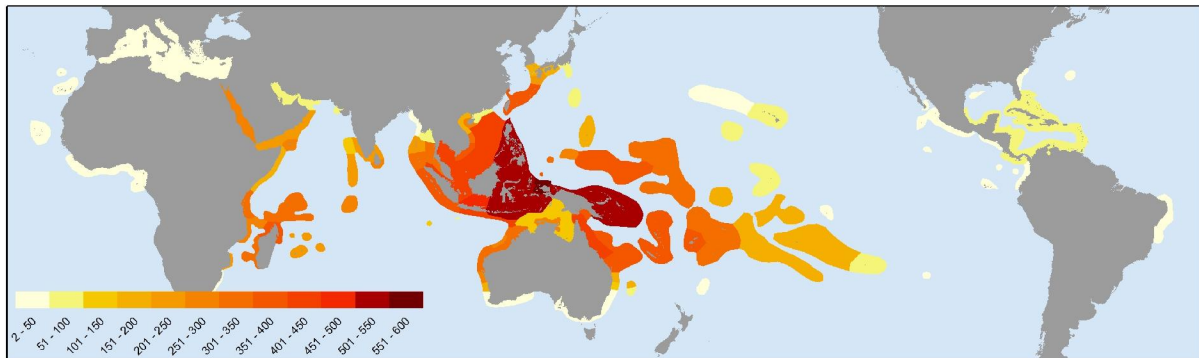
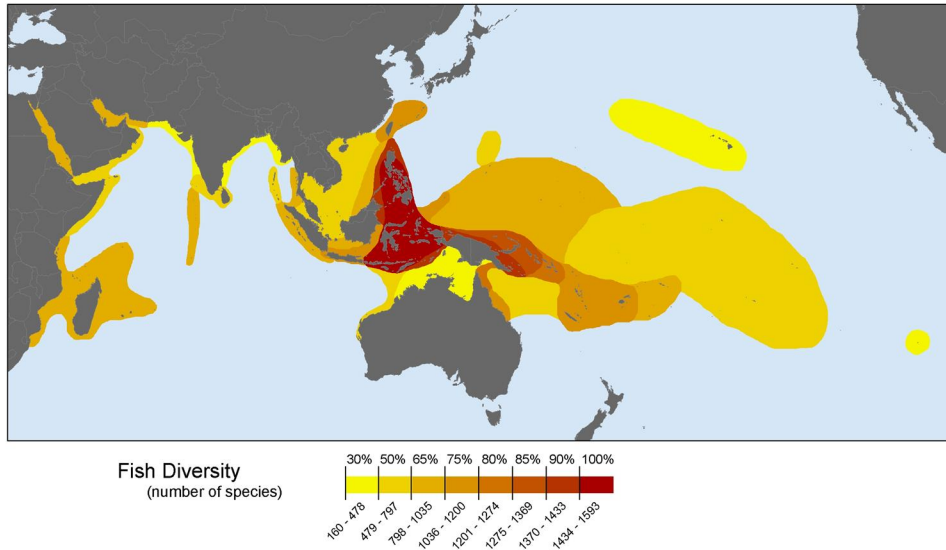


Figure 1. Biodiversity of reef building corals, showing the location of the Coral Triangle (> 500 species in each ecoregion: Veron et al. unpubl. data). Colours indicate total species richness per ecoregion.

2. Coral Reef Fishes (Allen 2007, unpubl. data)

- The Coral Triangle comprises the highest diversity of coral reef fishes in the world (Figure 2): **37%** (2228) of the **world's coral reef fish species** (6000), and 56% of the coral reef fishes in the Indo-Pacific region (4050). By comparison, 7% (420) of the world's coral reef fish species occur in the Hawaiian Islands.
- The highest concentration of reef fish species extends from south-eastern Indonesia to central Philippines.
- 8% (235 species) of the coral reef fishes in the CT are endemic or locally restricted species (Table 2). Coral Triangle countries have some of the highest numbers of endemic reef fish species in the world (particularly Indonesia, Philippines and PNG). Within the Coral Triangle, four areas have particularly high levels of endemism (Lesser Sunda Islands, Papua New Guinea – Solomon Islands, Bird's Head Peninsula, and Central Philippines). However because the number of species in the CT is very high, the % of endemic species is lower than some other parts of the world (e.g. Red Sea, Hawaiian Islands and Mascarene Islands).
- Ecoregions with highest levels of endemism in the CT are Papua, Lesser Sunda Islands, Palawan-North Borneo, and the Solomon Seas, with 14 to 19 endemic species recorded in each ecoregion (Table 2). Northeast Sulawesi and Eastern Philippines have lower levels of endemism, with 6 and 7 respectively. No endemics have been recorded in Sulawesi Sea/Makassar Strait, which is considered a transition zone between adjacent ecoregions.



Data source: Allen 2008 - unpublished data

Figure 2. Biodiversity of coral reef fishes, showing the location of the Coral Triangle (where more than 85% of the species in the Indo-Pacific region can be found: Allen unpubl. data). Colours indicate total species richness.

3. WHY IS THE CT SO DIVERSE?

The reason for the high diversity of the CT remains the subject of much scientific debate (reviewed in Hoeksema 2007). Some scientists believe that it is a major center of origin for coral reef species, where species originated and dispersed to other locations in the Indo-Pacific Region. While others believe that it is due to an overlapping or accumulation of faunas from the Indian and Pacific Oceans. Geological processes have also played an important role, with coral reef species evolving and persisting during low sea level events, demonstrating the resilient and enduring nature of these reefs during prior periods of climate change. Whatever the reason, it is clear that the large area and extraordinary range of habitats and environmental conditions have played a major role in maintaining the staggering biodiversity of the CT.

Table 1. Mean diversity of reef building corals of the ecoregions of the Coral Triangle (modified from Veron et al. unpubl. data).

Ecoregion	Mean diversity of reef building corals
Banda Sea	528.1
Bismark Sea	514
Eastern Philippines	532
Halmahera	543.7
Lesser Sunda	517.5
Northeast Sulawesi	525.5
Palawan/North Borneo	539.3
Papua	528.8
Solomon Archipelago	510.5
Solomon Sea	510.6
Sulawesi Sea/Makassar Strait	532.7

Table 2. Number (and percentage) of coral reef fish species and endemic reef fish species in the world, the Indo-Pacific Region and the CT and its ecoregions (modified from Allen 2007).

Region	Country or Area	Number of species	% of the total # of species in the world	# of endemic species	% endemism (% of total #)
World		6000	100.0%		
Indo-Pacific		4050	67.5%		
	West Pacific	2989	49.8%	938	31.4%
	Indian Ocean	2086	34.8%	532	25.5%
	Central Pacific	1403	23.4%	130	9.3%
Coral Triangle		2228	37.1%	235	7.8%
Ecoregions	Eastern Philippines	1763	29.4%	7	0.4%
	Palawan - North Borneo	1684	28.1%	14	0.8%
	Banda Sea	1728	28.8%	2	0.1%
	Papua and Halmahera	1660	27.7%	22	1.3%
	Northeast Sulawesi	1658	27.7%	6	0.4%
	Lesser Sunda Islands	1715	28.6%	19	1.1%
	Bismarck Sea	1493	24.9%	5	0.3%
	Solomons Archipelago	1403	23.4%	3	0.2%
	Solomon Sea	1603	26.7%	13	0.8%
	Sulawesi Sea/Makassar Strait	1717	28.6%	0	0

References

- Allen, G. R. 2000. Indo-Pacific coral-reef fishes as indicators of conservation hotspots. Proc. 9th ICRS, Bali, Indonesia. Vol 2: 921-926.
- Allen, G. R. 2007 Conservation hotspots of biodiversity and endemism for Indo-Pacific coral reef fishes. Aquatic Conserv: Mar. Freshw. Ecosyst. DOI: 10.1002/aqc.880.
- Briggs, J. C. 2005a. The marine East Indies: diversity and speciation. Journal of Biogeography 32: 1517-1522.
- Hoeksema, B.W. 2007 Delineation of the Indo-Malayan Centre of Maximum Marine Biodiversity: the Coral Triangle. Chapter 5 In: Renema, W. (ed). Biogeography, Time and Place: Distributions, Barriers and Islands., 117-178. Springer Publishing.
- Hughes, T.P., Bellwood, D.R., Connolly, S.R. 2002. Biodiversity hotspots, centers of endemism, and the conservation of coral reefs. Ecology Letters 5: 775-784.
- Roberts, C.M., McClean, C.J., Veron, J.E.N., Hawkins, J.P, Allen, G.R., McAllister, D.E., Mittermeier, C.G., Schueler, F.W., Spalding, M., Wells, F., Vynne, C., Werner, T.B. 2002 Marine biodiversity hotspots and conservation priorities for tropical coral reefs. Science Vol 292: 1280-1284.
- Veron, J.E.N. 1995. Corals in space and time: biogeography and evolution of the Scleractinia. UNSW Press, Sydney, Australia: xiii + 321 pp.
- Veron, J.E.N. 2000 Corals of the World. Australian Institute of Marine Science (3 volumes) 1,410pp.
- Veron, J.E.N., DeVantier, L.M., Turak, E. unpubl. data. Coral Geographic Weblink: http://www.coralreefresearch.org/html/crr_cg.htm
- Wallace, C.C., Richards, Z., Suharsono 2001 Regional distribution patterns of Acropora and their use in the conservation of coral reefs in Indonesia. Pesesir & Lautan Vol4, No 1; 1-19 pp.