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THE INDONESIAN SPONGE FAUNA: A STATUS REPORT

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ABSTRACT

Snellius-II sponge collecting yielded 355 species (together about 1300 specimens). An illustrated simplified key to the more common reef forms is presented using only field characters. A preliminary taxonomic review of the Indonesian sponge fauna is given based on an analysis of material collected during the Snellius-II Expedition, of older material of the Siboga Expedition (so far largely unpublished), and of data in the literature (most recent dating from before 1935).

The Indonesian sponge fauna, which is provisionally estimated to comprise 830 nominal species (obvious synonyms not counted) is compared to the fauna of relatively well-studied areas elsewhere in the Indo-Pacific region and to the West Indian sponge fauna, using numbers of species of each of 188 genera occurring in more than one of the areas concerned. Based on published reports the Australian tropical sponge fauna appears to be dissimilar to that of Indonesia.

1. INTRODUCTION

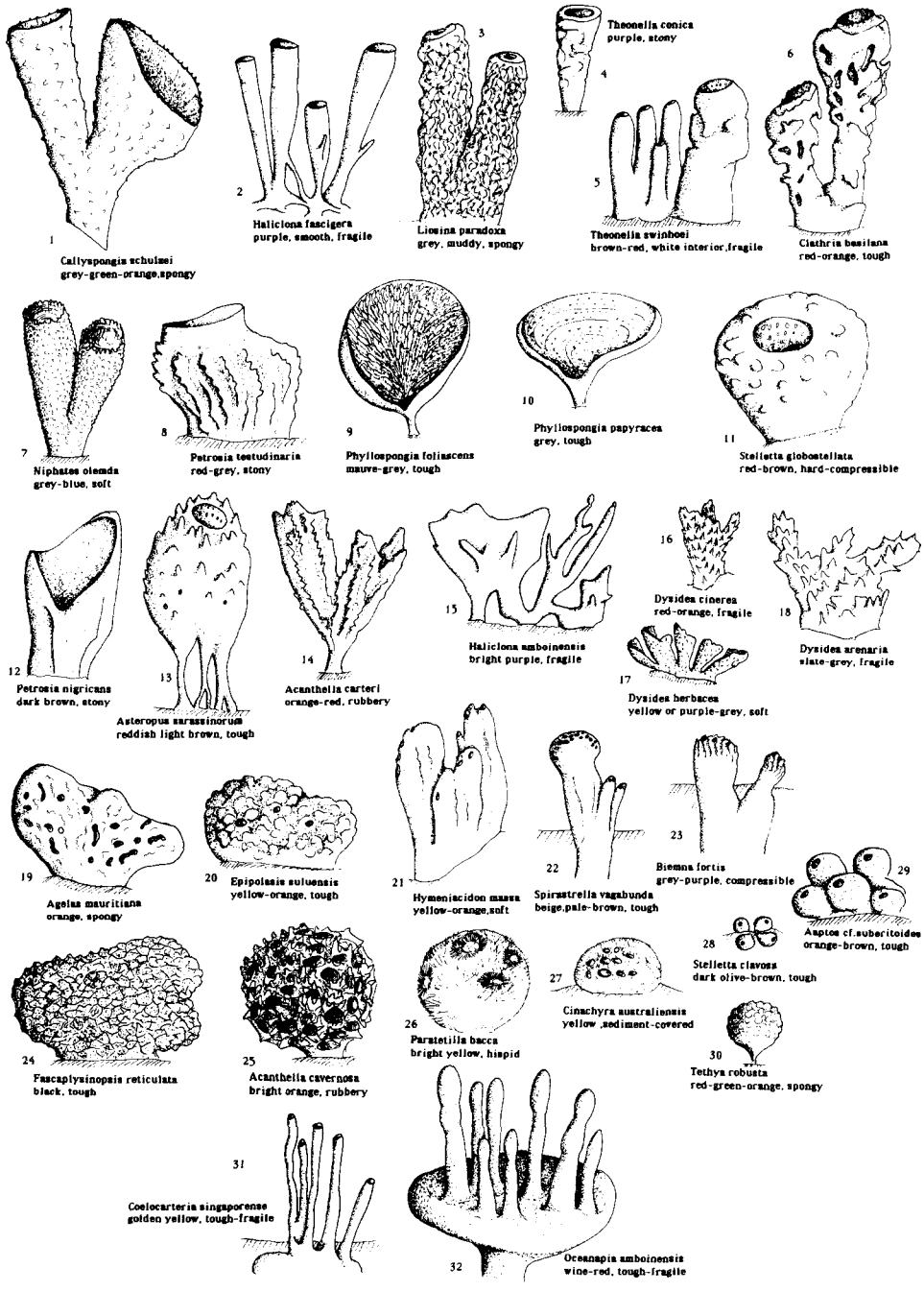
In a previous, preliminary report on the Snellius-II sponge project (VAN SOEST, in press) attention was focussed on the common reef sponges of eastern Indonesia. A total of 56 species was indicated as common in the area and their depth distribution was presented. Since then all collected sponge specimens were examined and this has resulted in a revision of this list. It is extended to comprise 59 species and some nomenclatorial corrections appeared necessary. In this final report the definitive list of common reef sponges is presented in the form of an illustrated key, which will enable provisional identification by non-specialists. Besides, the Snellius-II results were added to the information on Indonesian sponges already published or otherwise available to me (viz. identified collections of the Siboga Expedition in the 'Zoological Museum' Amsterdam). The combined information permitted a review of the Indonesian Demospongiae fauna (90% of the sponges belong in this group), which is also presented in this paper.

Despite the preliminary status of our knowledge of Indonesian demosponges, this fauna is compared to that of other tropical regions, in order to assess similarities (indicating shared histories) and differences (separate histories) between the Indonesian region and those other regions. Some incidental results of the Snellius-II sponge project were already published elsewhere (VAN SOEST, in press; VAN SOEST & VERSEVELDT, 1987).

Acknowledgments.—Dr J. van der Land enabled me to join the first cruise of theme 4. Drs Mario de Kluijver executed the statistic comparison of tropical sponge faunas using the University of Amsterdam Cyber computer.

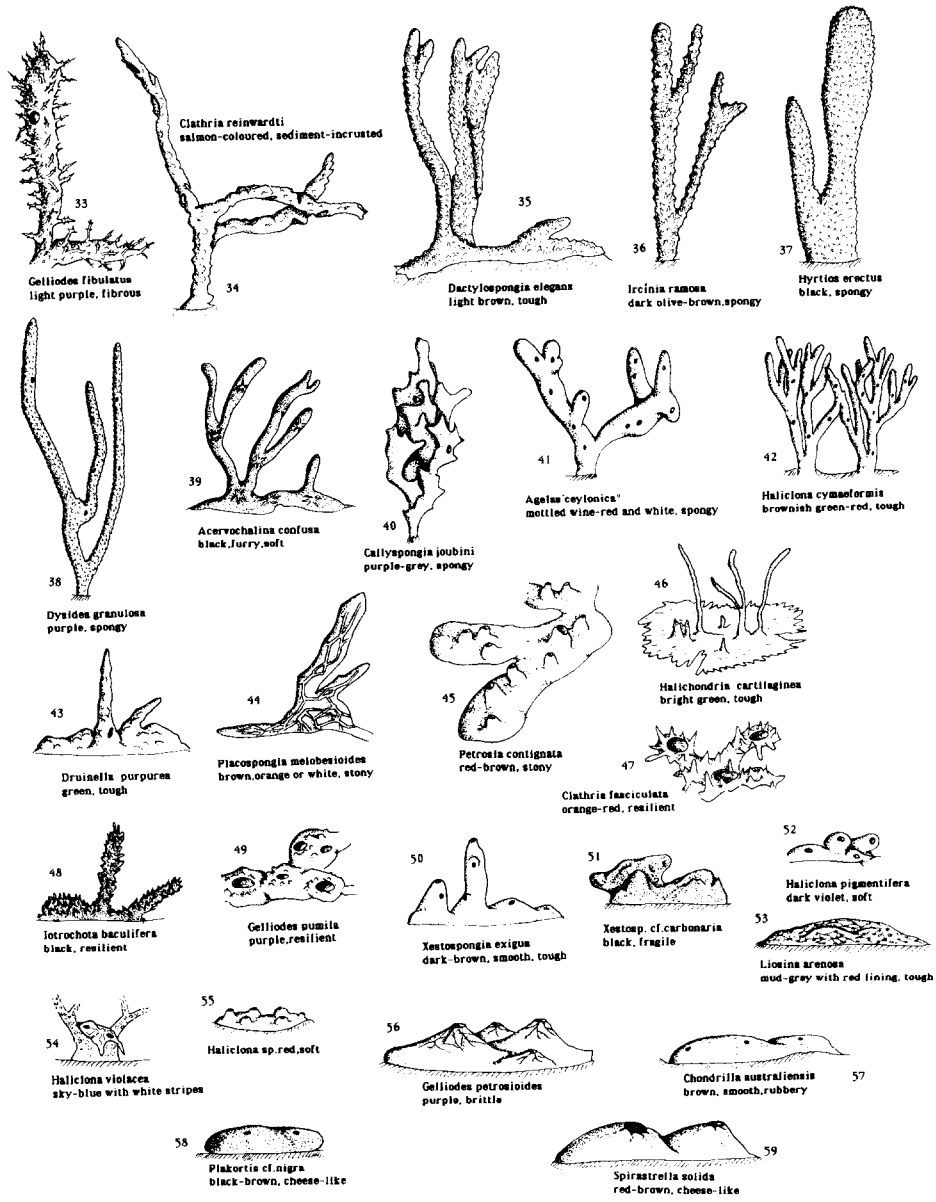
2. COMMON REEF SPONGES OF EASTERN INDONESIA

Below, an illustrated key is presented of sponges found to occur commonly on eastern Indonesian reefs. As was explained elsewhere (VAN SOEST, in press), the list is based on the first exploratory cruise of theme 4, in which 8 localities were visited. The nomenclature of a previously published list of these sponges was corrected in several instances: *Hymeniacidon conulosa* is now *H. massa*, *Psammaplysilla purpurea* is now *Druinella p.*, *Haliclona* cf. *nematifera* is merged with *Haliclona violacea* (*Nara nematifera* is different), *Axinella carteri* is now *Acanthella c.*, *Haliclona* cf. *turquoisia* is *H. fascigera*, *Callyspongia confoederata* is *C. schulzei*. Three species, *Spirastrella decumbens*, *Cliona* spec. and *Ircinia irregularis* turned out to be not as common as was previously assumed, and consequently are removed from the list. Seven others appeared to fall within the criterion of commonness (common in three or more of the localities visited) and are thus added to the list: *Dysidea arenaria* (depth range 4 - >15 m), *Biemna fortis*



(0 - 4 m), *Paratetilla bacca* (4 - >15 m), *Iotrochota baculifera* (0 - >15 m),*Clathria fasciculata* (4 - 15 m), *Haliclona pigmentifera* (0 - 4 m), *Chondrilla australiensis* (0 - 4 m). As a result the list is now extended to 59 species.

Nomenclature still remains problematical because not all species have been checked against type specimens yet. The revision of Indo-Pacific type specimens of common sponges is difficult since these are distributed over a large number of institutions and museums, all over the world.



Figs 1 and 2. Sketch drawings of characteristic habits of 59 species of common sponges, keyed out in the text.

Simplified illustrated key to the common reef sponges of eastern Indonesia:

The key is intended as a quick field guide for non-specialists, omitting all scientific terms and descriptions of internal anatomy (which is indispensable for a definite identification). The chosen species (choice based upon their relatively common occurrence in three or more of the eight areas vistited) are subdivided on their characteristic growth form into nine groups. Within these groups some further characteristics are provided which permit provisional identification. All species are represented by sketch drawings in Figs 1-2.

A. Tubes or pipes:

1. blue-green-grey, with sharp conules, resilient ..... *Callyspongia schulzei* (Kieschnick, 1900)
2. purple, quite smooth, fragile, easily torn ..... *Haliclona fascigera* (Hentschel, 1912)
3. grey, muddy appearance, undulating surface with network of fine grooves, spongy consistency ..... *Liosina paradoxa* Thiele, 1899
4. purple, indented-grooved surface, stony hard ..... *Theonella conica* (Kieschnick, 1896)
5. brown-red (white interior), smooth in small, grooved-indented in larger specimens, compressible but fragile ..... *Theonella swinhoei* Sollas, 1888
6. red-orange, indented or holed, spongy-compressible but tough ..... *Clathria basilana* Lévi, 1951
7. grey-blue, surface pilose- conulose, soft ..... *Niphates olemda* De Laubenfels, 1954

B. Cups and tubs:

8. often giant sized, red-grey, with heavily ridged outer walls, stony hard ..... *Petrosia (Xestospongia) testudinaria* (Lamarck, 1815)
9. cups or fans, thin-walled, mauve-grey, with characteristic grooved pattern on inside surface, tough *Phyllospongia foliascens* (Pallas, 1766)
10. cups or fans, thin-walled, grey, regularly spaced star-shaped oscules on inside surface, tough . *Phyllospongia papyracea* (Esper, 1794)
11. globular, with deep vent, red-brown, with widely spaced low rounded conules, hard-incompressible ... *Stelletta globostellata* (Carter, 1883)
12. irregular tubs or laminated masses, smooth surface, dark brown, stony hard ..... *Petrosia nigricans* Lindgren, 1897
13. stalked cup with narrow deep vent, reddish light brown, with rounded low conules, tough-compressible *Asteropus sarassinorum* (Thiele, 1899)

C. Fan-shaped:

14. irregular, with sharp ridges and conules, orange-red with yellow-orange sheen, rubbery ..... *Acanthella carteri* (Dendy, 1887)
15. irregular, often sending out thin branches, smooth, bright bluish purple, firm but easily damaged ..... *Haliclona amboinensis* Lévi, 1961
16. sharply conulose, laminated, red-orange, fragile, easily torn ..... *Dysidea cinerea* (Keller, 1881)
17. thin-walled, finely conulose, yellow-grey-purple, very soft ..... *Dysidea herbacea* (Keller, 1881)
18. irregular, roughly and heavily conulose, slate-grey, sandy-fragile ... *Dysidea arenaria* Bergquist, 1965
19. thickly, even massively laminated, with holes and pits, bright orange, spongy ..... *Agelas mauritiana* Carter, 1882

D. Massive structures:

20. thick masses with deeply grooved surface, yellow-orange, tough *Epipolasis suluensis* (Wilson, 1925)
21. wall-shaped, smooth, bright yellow-orange, soft, easily torn ..... *Hymeniacidon massa* (Carter, 1886)
22. tower-shaped, with side-branches, part-buried in the sandy substrate, oscules concentrated topside, where colour is darker than the pale-beige shaft, tough-hard .... *Spirastrella vagabunda* Ridley, 1884
23. tower-shaped masses similar to previous species, but with corrugated upper parts, conulose sides, compressible, fragile ..... *Biemna fortis* (Topsent, 1897)
24. large masses with reticulate surface, dark brown to black, hard but fibrous ..... *Fascaplysinopsis reticulata* (Hentschel, 1912)

E. Globular or ball-shaped:

25. rounded clathrate-cavernous masses consisting of intertwined trabeculae surrounding rounded cavities, bright orange ..... *Acanthella cavernosa* Dendy, 1922

26. ball-shaped with regularly spaced rounded crater-like pits between which the surface is hispid, bright yellow ..... *Paratetilla bacca* (Selenka, 1864)
27. ball-shaped, similar to previous species, but more squat and yellow colour obscured by sediment; crater-like pits smaller and more numerous ..... *Cinachyra australiensis* (Carter, 1886)
28. small, berry-shaped, olive-brown ..... *Stelletta clavosa* (Ridley, 1884)
29. masses of globular osculiferous lobes, orange-brown, rough to the touch but compressible; turns black in alcohol ..... *Aaptos cf. suberitoides* Brondsted, 1934
30. ball-shaped, covered with rounded tubercles, red-green-orange ... *Tethya robusta* (Bowerbank, 1875)

F. Fistulose:

31. main body buried in the sandy substrate, golden brown parchment-like fistules ..... *Coelocarteria singaporense* (Carter, 1883)
32. turnip-shaped main body, long smooth fistules with rounded closed ends, pale wine-red, tough but fragile *Oceanapia amboinensis* (Topsent, 1897)

G. Ramose:

33. very spinous, fibrous branches, erect or creeping, longer spines are themselves spined, light purple *Gelliodes fibulatus* (Ridley, 1884)
34. irregular undulating-conulose surface, often covered by sediment, salmon-coloured, compressible .... *Clathria reinwardti* Vosmaer, 1882
35. flattened branches, irregularly conulose, conules blunt, erect-creeping, light brown, very toughly spongy . *Dactylospongia elegans* (Thiele, 1899)
36. flattened branches, regularly conulose, dark olive-brown, toughly spongy *Ircinia ramosa* (Keller, 1881)
37. flattened branches, regularly conulose, black, toughly spongy ..... *Hyrtios erectus* (Keller, 1881)
38. thin, rounded branches, finely conulose, purple, spongy ..... *Dysidea granulosa* Bergquist, 1965
39. limp, soft branches rising from a broadly incrusting base, star-shaped oscules, furry black, soft ..... *Acervochalina confusa* Dendy, 1905
40. intertwined spinous branches, purple-grey, toughly spongy ..... *Callyspongia joubini* (Topsent, 1897)
41. smooth-lumpy branches, mottled wine-red-white, spongy, compressible ..... *Agelas "ceylonica"* (Dendy, 1905)
42. erect slender-branched bushes, brownish green-red, cartilaginous *Haliclona cymaeformis* (Esper, 1794)

H. Massive-creeping with upright branches:

43. regularly conulose, conules widely spaced and blunt, surface slippery, green (turns dark purple in alcohol), compressible ..... *Druinella purpurea* (Carter, 1880)
44. surface ornamented with system of angular grooves, brown-orange-white, stony hard ..... *Placospongia melobesioides* Gray, 1867
45. arm-thick creeping branches with thick-walled oscular chimneys, red-brown, stony hard ..... *Petrosia contignata* Thiele, 1899
46. mats covering the substrate with irregular thin upright branches, bright green, cartilaginous ..... *Halichondria cartilaginea* (Esper, 1794)
47. very spinous creeping masses-branches, large oscules, orange-red, toughly spongy ..... *Clathria fasciculata* (Wilson, 1925)
48. spinous masses issuing thick branches, black with dark purple exudate when squeezed, toughly spongy *Iotrochota baculifera* Ridley, 1884
49. creeping masses with variable presence of low conules, large oscules, purple, spongy-resilient ..... *Gelliodes pumila* (Von Lendenfeld, 1887)
50. massively incrusting with stiff erect branches or laminations, smooth, dark brown, tough-crumbly ..... *Xestospongia exigua* (Kirkpatrick, 1900)

I. Massively incrusting:

51. irregular, smooth masses, with flaky surface, black, fragile-brittle ..... *Xestospongia cf. carbonaria* (Lamarck, 1814)

52. lobate incrustations with large oscules, dark violet, very soft ... *Haliclona pigmentifera* (Dendy, 1922)
53. flatly incrusting with undulating surface, ornamented with network of fine grooves, mud-grey, grooves reddish, spongy ..... *Liosina arenosa* (Vacelet & Vasseur, 1971)
54. incrusting on (dead)corals, sky blue with white stripes, very soft . *Haliclona violacea* (De Laubenfels, 1950)
55. thickly incrusting with osculiferous chimneys, bright red, firm ..... *Haliclona* spec. red
56. massive, oscules slightly elevated, surface rough to the touch, subdermal canal system visible through fibrous skin, light purple, brittle-tough ..... *Gelliodes petrosioides* Dendy, 1922
57. rubbery-smooth, rounded, brown ..... *Chondrilla australiensis* Carter, 1873
58. cake-shaped, smooth, black-brown, cheese-like ..... *Plakortis cf. nigra* Lévi, 1967
59. thickly incrusting (excavating?), large oscules, red-brown, cheese-like tough consistency ..... *Spirastrella solida* Ridley & Dendy,1886

3. SNELLIUS-II SPONGE COLLECTION

All specimens (1300, including dredged material from the second part of theme 4 not attended by me), were examined and identified as far as was possible using all available literature and by comparisons with identified specimens of the Siboga collections. Thus a total of 355 species could be recognized as separate. Many could be named only provisionally, and about 50 seem to be definitely undescribed. These results must be considered tentative for reasons given above. The proper description of this huge collection will take dozens of years if taken on by a single taxonomist.

4. EASTERN INDONESIAN REGIONAL SPONGE FAUNAS

The provisional identification of all the Snellius-II sponge specimens retrieved from eight different geographic localities spread over a large part of eastern Indonesia allows a comparison of sponge faunas of these localities using a biogeographic similarity index (Czekanowski's coefficient: $2W/(A+B)\cdot 100\%$, in which W is the number of species shared by two areas, A and B are the total numbers of species in both areas). Cz-values obtained for each pair of two areas are presented in Table I. Six of the eight areas show few discrepancies in their Cz-values (areas 3-8, all 37% or higher). Areas 1 and 2 (Ambon and Pulau2 Maisel) show consistently lower Cz-values than the other six areas. These differences might be explained as a sign of regional faunal differences between localities east of the deep Banda Sea (Ambon and Pulau2 Maisel) and west of it (all other localities). However, since they both also show a very low Cz-value between each other, this conclusion is not really warranted. Also, Pulau2 Maisel was only visited for one day and this almost certainly accounts for the low Cz-values compared with other areas. Ambon was only sampled in the sediment-rich Ambon Bay, which likewise might count as a sampling bias. Consequently the conclusion must probably be that eastern Indonesian sponge faunas are rather uniform.

5. REVIEW OF THE INDONESIAN DEMOSPONGIAE FAUNA

Besides the Snellius-II sponge collection, the Institute of Taxonomic Zoology also harbours the large collections made by the Siboga Expedition (1898-99), with over 3000 sponge specimens, identified but only partly published upon by VOSMAER & VERNHOUT (1902), VOSMAER (1911), IJIMA (1927) and BURTON (1930). Thus, I can claim to have access to a reason-

TABLE 1
Sponge faunas of eight Indonesian localities compared using Czekanowski's biogeographic coefficient

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*area*
—	20	32	33	35	33	36	24	1: Ambon
	—	36	28	22	27	28	23	2: Pulau2 Maisel
		—	45	43	40	42	37	3: Tukang Besi
			—	42	44	41	36	4: Sumba
				—	44	44	44	5: Komodo
					—	46	37	6: Sumbawa
						—	39	7: Taka Bone Rate
							—	8: Salayer

ably representative collection of Indonesian sponges, collected from shallow reef flats, mangroves and sea grass meadows, coral reefs, continental slopes and abyssal localities. The data of the two large collections were combined with all data published on Indonesian sponges (HARTING, 1870; KIESCHNICK, 1896, 1898, 1900; TOPSENT, 1897 (recently redescribed by DESQUEYROUX, 1981); LINDGREN, 1897; SCHULZ, 1898; THIELE, 1899, 1903a, 1903b; HENTSCHEL, 1912; BRØNDSTED, 1934; many incidental records in different expedition reports, monographs, and notes). After elimination of all obvious synonyms, a preliminary checklist of Indonesian Demospongiae was constructed, omitting Hexactinellids (nothing substantial has been described since Ijima's excellent monograph) and Calcarea (at present very difficult to deal with pending generic and familial revisions). The checklist comprises about 780 nominal species; another 50 are assumed to be undescribed ; in all, 43% of the listed sponges are endemic to Indonesia. The checklist is available on request.

The revision of this formidable fauna of over 800 species represents a major challenge to sponge taxonomy, with considerable bearing upon and importance for the taxonomy of sponges in general. Such a challenge cannot be met with by single museum taxonomists working in isolation; it is imperative that teams of scientists are formed consisting of experienced senior taxonomists working in close cooperation with local scientists having access to the field.

6. COMPARISON OF THE INDONESIAN DEMOSPONGIAE FAUNA WITH OTHER TROPICAL REGIONS

Although the checklist of Indonesian demosponges is preliminary and many future emendations are to be expected, it is now possible to compare this list with (often equally preliminary) faunal lists from other regions of the tropical oceans (more or less comprehensively extracted from a large amount of literature), in order to find out to which areas Indonesia is most (dis)similar. The general biogeographic trend (BRIGGS, 1974) for major benthic taxa is that Indonesia is the central and richest part of a larger Indo-West Pacific region, which includes the north and central Pacific, the north and east coast of Australia, the central and western Indian Ocean, and the Red Sea. All these areas are reported to have some endemic sponge species (varying between 25 and 45% of the species reported from them in the literature); in the complement of their common sponges they are all dissimilar pointing at large local differences (VAN SOEST, in press). Endemism at the generic level, however, is quite low.

Unfortunately the description of the species,

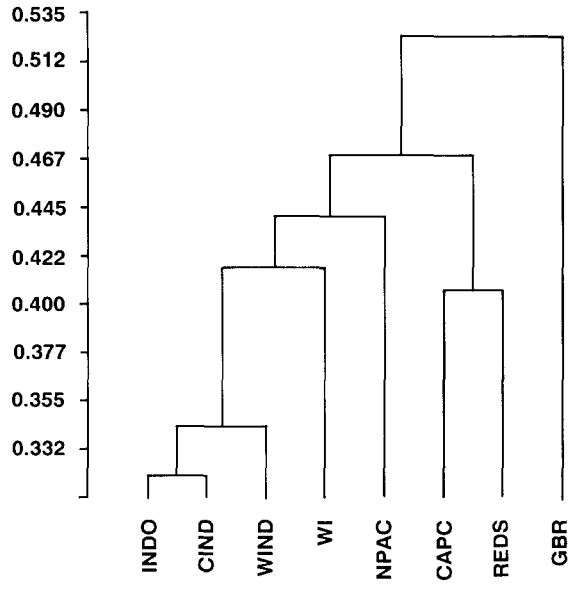


Fig. 3. Dendrogram of sponge faunas of eight tropical areas. Values indicate dissimilarity (0 = completely similar, 1 = completely dissimilar) as determined by Bray-Curtis dissimilarity index. (INDO = Indonesia, CIND = Central Indian Ocean, WIND = Western Indian Ocean, WI = West Indian region, NPAC = North Pacific, REDS = Red Sea, CPAC = Central Pacific, GBR = North and East Australia).

especially in the older literature, is often too vague and type specimens have been so seldom reexamined that a comparison of lists of actual species seems a meaningless and unreliable effort. However, it is possible at this stage of our knowledge, and with some editing of the generic assignments made by the different authors, to compare the numbers of species of each genus (regardless of their identities) reported from more than one of the areas concerned. This method also makes it possible to draw the West Indian region into the comparison. A matrix table was constructed of 188 genera (the total of all tropical sponge genera diminished for practical reasons by the number of genera occurring in only a single of the eight areas considered) and their numbers of species in the eight areas, expressed as percentage of the total number of species recorded for each area. Similarities of the areas considered were compared using the Bray-Curtis dissimilarity index in combination with Average Linkage clustering procedure (see KAANDORP, 1986). The processing of the data yielded the dendrogram of Fig. 3, showing that the Indonesian fauna is most similar to Indian Ocean faunas and also to that of the West Indies (although endemism in the latter area is close to 100%), and the neighbouring north Pacific. Such similarities are easily explained by common history of the tropical seas dating back to the Tethys. More peripheral

areas such as the central Pacific and the Red Sea are increasingly dissimilar, which is in accordance with the general biogeographic trend. Remarkably, however, the Australian area (Great Barrier Reef) is highly dissimilar to Indonesia. It is possible that we are again dealing with a sampling bias, because the published accounts of the Great Barrier Reef sponge fauna probably do not nearly cover what really occurs there.

On the other hand, there is room for the hypothesis that the Australian region has a distinct element of its own, no doubt dating back from the time that Australia was not in contact with the tropical Asian fauna (KNOX, 1980). The south Australian subtropical/temperate fauna shows a high level of generic endemism with many peculiar forms, *e.g.* the 'sand sponges'. Possibly, invasions of tropical (reef-) sponges from the Asian tropical region into the NE Australian region has not so completely replaced local Australian elements as was apparently the case in other animal groups.

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