Malaysian Hard Corals

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Executive Summary

- The Eastern Peninsular Malaysia area has a very diverse hard coral fauna. A total of 227 species in 66 genera were observed and identified during this brief study, which is approximately 80% of the number of species (and 94% or more of the genera) identified by the same author using the same method at an equivalent number of sites in each of three countries: the Philippines, Indonesia, and Papua New Guinea. Those three countries have the greatest coral diversity known on earth, and are known as the "Coral Triangle".
- A total of 68 species were identified which have not previously been reported in published reports of the corals of all of Malaysia, bringing the total number of species known from Malaysia to 324. A total of 120 species were identified which have not previously been reported from anywhere on Peninsular Malaysia.
- Four species were found which were previously thought to be endemic to other countries. Three of these species were previously known only from the Philippines, and one was known only from Japan.
- One new species of coral was collected (from outside the Marine Park), of genus *Lobophyllia*. Seven additional species were sighted, some of which may prove to be new species once collected.
- Primary threats to the reefs of these three marine parks appear to be: 1. nutrient runoff from human activities on the islands, 2. Sediment runoff from forest clearing on the islands, 3. Mass bleaching due to high water temperatures. Crown-of-Thorns and snails offer lesser threats.

Fishing, anchoring, rubbish, diving, and snorkeling appear to be relatively well controlled at present but could pose problems in the future.

Methods

A list of coral species was recorded at each site. The basic method consisted of underwater observations during two, 60- minute dives at each site by D. Fenner. The name of each species identified was marked on a plastic sheet on which species names were printed. A initial descent was made in most cases to the base of the reef, to or beyond the deepest coral visible. The bulk of the dive consisted of a slow ascent along the reef in a zigzag path to the shallowest point of the reef or until further swimming was not possible. Sample areas of all habitats encountered were surveyed, including sandy areas, walls, overhangs, slopes, and shallow reef. Many corals can be identified to species with certainty in the water and a few must be identified alive since they cannot be identified without living tissues. There are also a few that are easier to identify alive than from skeletons. Field guides assisted identification (Nishihira and Veron, 1995; Wallace and Wolstenholme, 1998). However, there are species that normally require collection to identify. A number of species were in fact sighted which could not be identified (without collection), so it is clear that the total coral fauna exceeds that identified in this report. Some species can be tentatively identified in the field, but are best confirmed by the collection of a sample. No samples were collected; these species are indicated by a "?" following the species name. Additional references that provided background material for the identification of species are listed in references (Best & Hoeksema, 1987; Best & Suharsono, 1991; Boschma, 1959; Claereboudt, M. 1990; Dai, 1989; Dai & Lin 1992; Dineson, 1980; Hodgson & Ross, 1981; Hoeksema, 1989; Hoeksema & Best, 1991; Hoeksema & Dai, 1992; Moll & Best, 1984; Nemenzo 1986; Ogawa & Takamashi, 1993, 1995; Randall & Cheng, 1984; Sheppard, 1998; Sheppard & Sheppard, 1991; Veron, 1985, 1990, 2000; Veron & Pichon 1976, 1980, 1982; Veron, Pichon & Wijman-Best, 1977; Veron & Wallace, 1984; Wallace 1994, 1997a, 1999; Wallace & Dai, 1997; and Wallace & Wolstenholme 1998).

The primary group of stony corals is the zooxanthellate scleractinian corals, that is, those that contain single-cell algae and which contribute to building the reef. Also included are a small

number of zooxanthellate non-scleractinian corals which also produce large skeletons which contribute to the reef (e.g., *Heliopora* and *Millepora*), a small number of azooxanthellate scleractinian corals (*Tubastrea* and *Rhizopsammia*), and one azooxanthellate non-scleractinian coral (*Distichopora*). All produce calcium carbonate skeletons which contribute to reef building to some degree.

Results

A total of 227 species in 66 genera of stony corals (216 species in 60 genera of zooxanthellate Scleractinia) were found in the three Marine Park areas of Eastern Peninsular Malaysia. Several additional species were sighted, but could not be identified without collecting a sample. And additional searching will certainly increase the number of species found, so the total number of coral species in this area is well over that found in this brief study. Many of the species identified are illustrated in Veron (1986) or Nishihira and Veron (1995), and all will be illustrated in Veron (in press) and Veron, Fenner and Stafford-Smith (in press). Previous studies (Betterton, 1981; de Silva et al, 1980; Pillai & Scheer, 1974; Rahman, 1986) reported a maximum of 169 species for Peninsular Malaysia (de Silva et al, 1980), and include several species names that are no longer considered valid.

The number of coral species identified during this brief study is approximately 80% of the number of species (and 94% or more of the genera) identified by the same author (D. Fenner) using the same method at an equivalent number of sites in each of three countries: the Philippines, Indonesia, and Papua New Guinea. To compare equivalent data, just the species found on the first dive of each site in Malaysia could be used, since the other studies involved just one dive per site. In this study, there were a total of 202 species in the first dives of the 17 sites, while in the Philippines there were 249 species, in Papua New Guinea there were 257 species, and in Indonesia 250 species after 17 sites. Those three countries have the greatest coral diversity known on earth, and are known as the "Coral Triangle". Each of these countries has over 400 species of coral that have been reported, and quite a few additional species that have been found but not yet published. The total number of species in any of the three countries is thus not yet known, but is very high indeed. By comparison, the Caribbean and Hawaii each have only about 50 species of reef-building corals. And yet, reefs in both these areas are considered well worth

significant protection efforts. Thus, Eastern Peninsular Malyasia has a very high coral species richness, and a world-class diversity that is worthy of detailed study and world-class protection efforts.

Among the 227 species of coral identified in this study, there are 68 species that have never been reported before in a published report from anywhere in Malaysia, including Sarawak and Sabah. Prior to this study, 256 species of coral were reported from all of Malaysia in the most definitive report to date (Veron, 1983). Thus, the total number of species now known from Malaysia is 324, quite close to 80% of the number reported from Coral Triangle countries (about 411 species). The finding of 68 additional species in such a brief study supports the view that additional studies of Malaysia's corals will reveal many more species. Table 2 presents the 68 species not previously reported from Malaysia. Confirmation from collected specimens would be required before publication of this list.

Among the 227 species corals identified here, there was a total of 120 species that have never been reported from Peninsular Malaysia (both coasts) in a publication. This is half of the total species found in this study, and indicates that the Peninsular waters have not been well-studied. Table 3 presents the 120 species not previously reported from Peninsular Malaysia. Previous publications have reported 44 species in Peninsular Malaysia which were not found in this study, bringing the total number of species known from Peninsular Malaysia to 271 species, or 84% of the number of species known from the entire country.

Among the species identified, a few are of particular importance. Four species were found which had each previously been reported from only one country. Three had previously been reported only from the Philippines, and one had been reported only from Japan. Each of these species was previously considered to be endemic to the country in which it was discovered, that is, to only exist there. Each of the four species was rare in Malaysia. The four species are presented in Table 4.

Differences between the three island groups were relatively small. Table 2 presents the number of hard corals in each island group, along with the number in just the first 4 sites, and the average number of species per site.

Table 2. Number of hard corals in the three island groups.

Island Groups	Total no. species	Total sp. in 4 sites	av. no. of species/site
Pulau Redang	149	143	87
Pulau Tioman	183	160	83
Pulau Tingii	153	151	81

Threats to Reefs:

The principal threat to reef health at this time appears to be nutrient runoff from human activities. Nutrients added to reef systems can foster algal blooms. Algae compete with corals for living space and light. At this point there are significant areas of reef which have a large percentage of dead coral, most likely killed in a mass bleaching event in 1998 (possibly also by Crown of Thorns seastars). Algae growing on that coral is competing with small living remnants of the corals and newly settled juvenile corals. Added nutrients could shift the balance in favor of the algae, retarding the recovery of the corals or even stopping their recovery. The threat is greatest near the largest concentrations of people and downstream from those areas, and least in areas of the smallest human populations. Proper sewage systems and runoff controls are some of the tools that can control this problem.

A second major threat to reef health is sediment runoff. Where humans cut trees and clear land for building or agriculture, or disturb existing ground cover as in the construction of buildings or roads, large quantities of fine soil particles are carried by rainwaters into the ocean. Runoff is much higher during rainy seasons than dry seasons, and can be particularly great during periods of heavy rain. The fine soil particles which are suspended in the ocean waters near shore decrease visibility, discouraging visitors who wish to snorkel or dive, and spoiling the beauty of nearshore waters. The sediment blocks light, reducing the growth of coral. Then the sediment slowly settles out of the water, falling on corals. The corals must clean themselves as fast as the sediment settles, or else they will be burried and smothered to death. So there is a maximum rate of sedimentation that corals can survive, which differs between coral species with their cleaning abilities. At high rates of sedimentation, all corals will be buried by sediments and killed. The forests on these islands are largely uncut; cutting these forests would not only mar the landscape, it would be certain to kill all the reefs (which are all fringing reefs close to shore).

Mass bleaching of corals occurs when water temperatures exceed the highest temperature normally reached in the hotest month of the year. About 1 degree over the normal high temperature is sufficient to cause corals to expel their symbiotic algae. Because most of the color of a coral is in the algae, the corals are left looking white after the algae are expelled, hence the term “bleached”. About 2 degrees or more over the normal high temperature is enough to not only bleach the coral, but cause it to die within a few weeks. Temperature rises of between 1 and 2 degrees usually cause corals to bleach, but the corals may recover their algae within a few months and recover normal health. Some scientists have suggested that bleaching may occur more often and be more severe in coming years due to global warming. Although global warming can not be altered by small projects, other threats from humans such as nutrients and sediment can be controlled, to allow reefs the best possible chance of recovery following bleaching episodes. Training in recognizing bleaching and awareness should be undertaken, and plans formulated to monitor any bleaching episode in progress.

Crown-of-Thorns sea stars were seen, especially at Redang. These large sea stars eat the living tissue off of corals, and can do a great deal of damage when they occur in large numbers. Most of the evidence at this point indicates that outbreaks of these seastars may be natural. Still, they can cause significant or severe damage to reefs. If present in very large numbers, their numbers are too large for control efforts on a large scale. However, if they occur on small reefs that are particularly important (for tourism or other reasons), local contol efforts can be successful and well worth the expense and effort. If, for example, even small numbers of these seas stars are found on heavily snorkeled or dived reefs such as the reef in front of the Redang Park Headquarters, they should be removed immediately. Removal to a land site is the superior method, since no toxic chemicals are released into the environment, and the unsightly decaying carcasses are removed from the reef.

A second, less threatening animal which eats coral is the small snail, *Drupella*. This snail is normally present on healthy reefs where it does minimal damage. Only rarely does it do significant damage, and it appears to be a natural phenomonon. On the other hand, if they become common enough to do visible damage on the most heavily used (and thus valuable) reefs, a removal campaign should be undertaken. Because these snails and their damage are not easily recognized, training programs for parks staff and dive leaders are needed to make it possible to recognize the snails before they become a problem.

Coral diseases were not recognized in this study, but could be a significant threat. Training to recognize coral disease would be warrented.

Additional threats from humans include mechanical damage from boat anchors, nets, rubbish, divers, snorkelers, and fishing. All of these appear to be fairly well controlled at this point by the excellent programs of the Marine Parks. Few fishing nets and traps were observed on the reefs and relatively good fish populations were observed. Fishing nets need to be removed by dive teams and fish traps opened. A few large fish were observed; large fish are sensitive indicators of fishing pressure- even small amounts of fishing quickly reduce the populations of large fishes. No lobsters, Trident shells, or the largest species of Giant Clam (*Tridacna gigas*) were seen, although they are protected. They may have been fished to local extinction before the Marine Parks were established. These species should be re-introduced if possible. Some rubbish was observed at a couple of reefs. Two of the island groups have well-organized rubbish remove services and we saw no visible rubbish on reefs. The third island group does not yet have rubbish removal service; such a service would likely help. Very little damage was observed from anchors, divers, or snorkelers, and no damage from blast fishing. An excellent system for controlling damage from snorkelers has kept damage to a bare minimum, and dive operators seem to be quite concienscious in fostering diving without contacting coral. Additional mooring buoys will be needed if tourism continues to expand. New Parks programs do not appear to be needed at this point, but with increasing tourism, expansion and/or addition to Marine Parks programs may be necessary.

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Appendix 1:

Five species do not have site records; four were identified from photos which could not be assigned to sites, and one was identified by recall without a site number.

Species listed as "sp." such as "*Montipora* sp. 1", are species which will be named and described in Veron, 2000. The new species of *Lobophyllia* is listed as "*Lobophyllia* undescribed".

Appendix A:

Corals found which have not previously been reported from anywhere in Malaysia in published reports:

1. *Pocillopora danae*
2. *Pocillopora meandrina*
3. *Stylophora subseriata*
4. *Montipora altisepta*
5. *Montipora cebuensis*

6. *Montipora confusa*
7. *Montipora* sp. 1
8. *Montipora gaimardi*
9. *Montipora malampaya*?
10. *Montipora* sp. 2
11. *Montipora* sp. 3
12. *Anacropora matthai*
13. *Acropora austera?*
14. *Acropora bruggemani*
15. *Acropora dendrum*
16. *Acropora digitifera*
17. *Acropora gemmifera*
18. *Acropora hoeksemai?*
19. *Acropora horrida*
20. *Acropora monticulosa*
21. *Acropora prostrata*
22. *Acropora rosaria*
23. *Acropora samoensis*
24. *Acropora selago*
25. *Acropora solitaryensis? or glauca?*
26. *Acropora stoddarti?*
27. *Acropora vermiculata?*
28. *Acropora yongei*
29. *Porites evermanni*
30. *Porites monticulosa*
31. *Goniopora planulata?*
32. *Psammocora explanulata*
33. *Psammocora superficialis*
34. *Coscinaraea exesa*
35. *Coscinaraea hahazimaensis*
36. *Pavona bipartita*
37. *Leptoseris incrustans?*
38. *Pachyseris foliosa*
39. *Fungia klunzingeri*
40. *Fungia moluccensis*
41. *Ctenactis albitentaculata*
42. *Podabacia motuporensis*
43. *Galaxea sp. 1*
44. *Oxypora crassispinosa*
45. *Pectinia maxima*
46. *Scolymia australis*
47. *Acanthastrea hemprichii*
48. *Acanthastrea lordhowensis*
49. *Acanthastrea sp. 1*
50. *Lobophyllia sp. 1*
51. *Lobophyllia sp. 2*

52. *Lobophyllia sp. 3*
53. *Hydnophora grandis*
54. *Favia maritima*
55. *Favia sp. 1*
56. *Favia veroni*
57. *Favites acuticollis (sp?)*
58. *Favites sp. 1*
59. *Goniastrea favulus*
60. *Goniastrea sp. 1*
61. *Montastrea sp. 1*
62. *Platytyra contorta*
63. *Platygyra verweyi*
64. *Echinopora pacificus*
65. *Euphyllia yaeyamensis*
66. *Turbinaria irregularis*
67. *Balanophyllia sp.*
68. *Rhizopsammia verrilli*

Coral species previously not reported in published literature from Penninsular Malaysia (both coasts):

1. *Pocillopora danae*
2. *Pocillopora meandrina*
3. *Stylophora subseriata*
4. *Montipora aequituberculata*
5. *Montipora altisepta*
6. *Montipora cebuensis*
7. *Montipora confusa*
8. *Montipora* sp. 1
9. *Montipora gaimardi*
10. *Montipora malampaya?*
11. *Montipora millepora*
12. *Montipora* sp. 2
13. *Montipora* sp. 3
14. *Anacropora matthai*
15. *Acropora austera?*
16. *Acropora bruggemani*
17. *Acropora cerealis*
18. *Acropora cytherea*
19. *Acropora dendrum*
20. *Acropora digitifera*
21. *Acropora gemmifera*
22. *Acropora hoeksemai?*
23. *Acropora horrida*
24. *Acropora loripes*
25. *Acropora monticulosa*

26. *Acropora nobilis*
27. *Acropora prostrata*
28. *Acropora rosaria*
29. *Acropora samoensis*
30. *Acropora secale*
31. *Acropora selago*
32. *Acropora solitaryensis ?* or *glauca?*
33. *Acropora stoddarti?*
34. *Acropora valenciennesi*
35. *Acropora valida*
36. *Acropora vermiculata?*
37. *Acropora yongei*
38. *Astreopora gracilis*
39. *Astreopora ocellata*
40. *Porites annae*
41. *Porites evermanni*
42. *Porites monticulosa*
43. *Goniopora planulata?*
44. *Psammocora explanulata*
45. *Psammocora nierstraszi*
46. *Psammocora profundacella*
47. *Psammocora superficialis*
48. *Coscinaraea collumna*
49. *Coscinaraea exesa*
50. *Coscinaraea hahazimaensis*
51. *Pavona bipartite*
52. *Leptoseris explanata*
53. *Leptoseris incrustans?*
54. *Leptoseris mycetoseroides*
55. *Leptoseris papyracea*
56. *Leptoseris scabra?*
57. *Pachyseris foliosa*
58. *Cycloseris erosa*
59. *Cycloseris patelliformis?*
60. *Diaseris distorta*
61. *Diaseris fragilis*
62. *Fungia concinna*
63. *Fungia granulosa*
64. *Fungia klunzingeri*
65. *Fungia moluccensis*
66. *Fungia paumotensis*
67. *Fungia scruposa*
68. *Ctenactis albitentaculata*
69. *Ctenactis crassa*
70. *Herpolitha weberi*
71. *Lithophyllon undulatum*

72. *Podabacia motuporensis*
73. *Galaxea* sp. 1
69. *Echinophyllia echinata*
74. *Echinophyllia orpheensis*
75. *Oxypora crassispinosa*
76. *Mycedium elephantotus*
77. *Pectinia alcicornis*
78. *Pectinia maxima*
79. *Pectinia paeonia*
80. *Blastomussa wellsi*
81. *Cynarina lacrimalis*
82. *Scolymia australis*
83. *Scolymia vitiensis*
84. *Acanthastrea hemprichii*
85. *Acanthastrea lordhowensis*
86. *Acanthastrea* sp. 1
87. *Lobophyllia corymbosa*
88. *Lobophyllia* sp. 1
89. *Lobophyllia* sp. 2
90. *Lobophyllia* sp. 3
91. *Hydnophora grandis*
92. *Merulina scabricula*
93. *Caulastrea tumida*
94. *Favia maritima*
95. *Favia sp. 1*
96. *Favia veroni*
97. *Favites acuticollis*
98. *Favites* sp. 1
99. *Goniastrea favulus*
100. *Goniastrea* sp. *1*
101. *Platytyra contorta*
102. *Platygyra verweyi*
103. *Montastrea curta*
104. *Montastrea* sp. 1
105. *Montastrea magnistellata*
106. *Plesiastrea versipora*
107. *Leptastrea pruinosa*
108. *Echinopora gemmacea*
109. *Echinopora pacificus*
110. *Trachyphyllia geoffroyi*
111. *Euphyllia ancora*
112. *Euphyllia divisa*
113. *Euphyllia yaeyamensis*
114. *Catalaphyllia jardini*
115. *Turbinaria irregularis*
116. *Turbinaria mesenterina*

117. *Turbinaria stellulata*
118. *Balanophyllia* sp.
119. *Rhizopsammia verrilli*
120. *Tubastraea coccinea*

Coral species previously reported from only one country ("endemic"):

Species	Country previously known from
1. *Montipora confusa*	Philippines
2. *Coscinaraea hahazimaensis*	Japan
3. *Pachyseris foliosa*	Philippines
4. *Oxypora crassispinosa*	Philippines