

Some observations on marine life at Pulau Aur, Johore¹

DAPHNE FAUTIN DUNN²

Pulau Aur is an island of approximately 5.7 square miles area, lying fifty miles off the east coast of West Malaysia in the South China Sea, due east of the port town of Mersing, Johore, between latitudes 2°25'30"N and 2°28'30"N, and longitudes 104°30'0"E and 104°33'0"E. This island is fringed by a coral reef and has yellow sand beaches interspersed with rocky promontories on the leeward side, while the beaches on the windward (eastern) side are composed of sizeable boulders. The entire island, as well as the three small ones surrounding it, is built of a fine-grained granite. The two peaks comprising the island (1378 feet and 1710 feet) have fairly steep sides and this characteristic continues beyond the beaches into the water, so that the sea attains great depth very near shore. For further description of the island and its history, see Dalton (1928) and Marchette (1964).

The following observations were made during the period 24–29 April, 1968, at the south end of Telok Miang, a small bay without permanent human settlements on the northern part of the west side of the island. This area was chosen because of rocky and sandy beaches in close proximity, a slope sufficiently gradual to permit study of a reasonably sized area of a depth not prohibitive to free diving (no scuba gear was used), and its ease of access.

METHODS

The quantitative physical measurements made were of a very elementary sort, using unsophisticated equipment readily available in a secondary school science laboratory. Thus this paper might provide teachers in schools near shore environments with some ideas for introductory marine studies.

To measure distance, heavy twine, wetted to prevent stretching, was held firmly between two observers, or between an observer and a fixed point. All measurements affected by tide level were determined at a period of intermediate (*i.e.* neither high nor low) tide. The outer limit of the study area was marked by a row of balloons attached with twine to rock or coral weights. These buoys also served to define sectors that were assigned to individual investigators for collection and observation.

¹ Made by Peace Corps Volunteers Ronald Brant, Sharon Clarke, Ellin Doyle, Daphne Fautin, Eric Foell, Howard Takata, Ellen Thaler, JoAnna Woo and Henry Young.

² Department of Zoology, University of California, Berkeley, California 94720.

Visibilities were estimated using twine and objects held or suspended in the water. These determinations would have been more meaningful had a Secchi disc been available. Temperature readings were made with an ordinary mercury thermometer.

OBSERVATIONS

The substratum near the shore of the study area was sandy, strewn with broken dead coral and occasional rocks off both the rocky and the sandy beaches. Tidal fluctuation during the period of the study was approximately one metre. At low tide a strip extending approximately 10 to 15 m from the shoreline was nearly uncovered. At about 50 m from shore, the sea floor dropped suddenly from 5 m to 8 m and more. This drop roughly marked the outer limit of the study area. The region of the drop was characterized by numerous rocky caverns and dense coral growth. Between the shallow, sandy area and the edge of the study area, the bottom sloped gradually and was generally covered with a great variety of corals, mostly living.

During the period of the study, the weather was both sunny and rainy. Observations were made between 9.00 a.m. and 3.00 p.m., when the air temperature varied between 27.5°C and 30.0°C, while water temperature at the surface read slightly more than 28.5°C and that at depths of 3 and 6 m was consistently 28.5°C. (Some scuba divers working nearby at the same time recorded no temperature change at all down to a depth of 25 m). Litmus paper was unaffected by the water. Wave action during the period of the study was slight, and inhabitants of the island reported that even during the monsoon season (November until March), certain of the bays on the leeward side remain calm. Turbidity, as indicated in the visibility estimates, was slight. Visibility at the periphery of the study area was measured vertically at about 17 m and horizontally, immediately below the surface, at about 16 m on an overcast day.

The fauna and flora observed (no large floral species were encountered, and because equipment to investigate microscopic plankton was not available, biological observations were almost exclusively on the fauna) were nearly all benthic, the only pelagic forms being some coelenterates and larger nektonic vertebrates, as listed below.³

Vertical zonation was somewhat difficult to ascertain at Pulau Aur. In addition to diving in the study area, dives were made at five other sites off Pulau Aur and its satellite islands, Pulau Dayang, Pulau Lang and Pulau Pinang. The assemblage of organisms at each site differed quite markedly although the depth at which collections and observations

³ benthic = bottom-dwelling; pelagic = inhabiting the mass of water (opposite of benthic); nektonic = free-swimming, independent of currents and wave action.

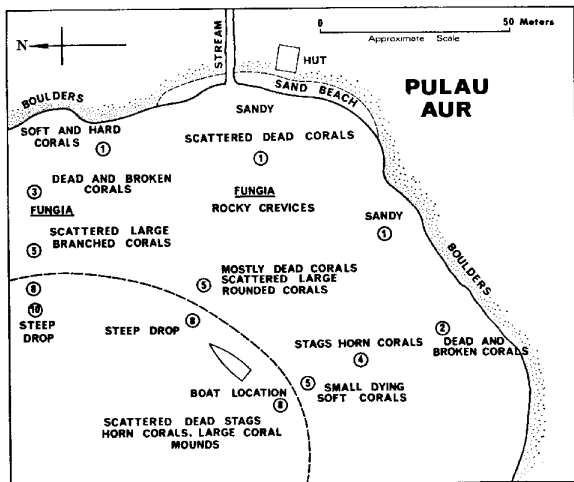


FIGURE 1. Sketch map of Telok Miang study area indicating locations of predominant biological and physical features. Circled numbers denote approximate depth in metres.

were made was constant, indicating that factors other than depth seemed to govern the distribution of many organisms.

However, some generalizations concerning vertical zonation in the study area may be made. The sandy-bottomed, near-shore, shallow portion was nearly devoid of life, only the scavenger sea cucumber, *Holothuria atra*, being in evidence, feeding on detritus washed in by waves. Peculiar shallow mounds of sand, a foot or two across and not more than a few inches high, with a small depression in the center at the top, seemed characteristic of this area. Occasionally they emitted a cloud of sand, but probing them, and even digging rapidly downward, revealed nothing. Dead and broken coral and shell, which had also been washed in, littered the sand among the rocks of this area.

The central belt, varying in depth from 3 to 5 m, was characterized by *Fungia* and similar discoid, solitary corals of the family Fungiidae off the sandy shore. Stag's horn coral (*Acropora*) seemed to predominate off the rocky shore, and throughout the area the living corals were interspersed with dead coral heads. It was in this strip (extending to the edge of the drop) that nearly all collecting was done. Thus most of the organ-

isms listed below were found in this environment and at these depths. Toward the edge of the drop the separation between the two sorts of coral disappeared. Immediately beyond the drop the bottom was strewn with dead *Acropora* which probably tumbled or was carried over the brink from the extensive beds above (Figure 1).

SYSTEMATIC LIST OF FAUNA OBSERVED
IN THE STUDY AREA⁴
(compiled by all participants)

PHYLUM PORIFERA — sponges

Class Demospongiae

Cliona sp

Several species of brightly coloured (red, orange, purple) encrusting forms.

PHYLUM COELENTERATA

Class Hydrozoa

Pennaria sp

Plumularia sp

Millepora sp

Class Scyphozoa — jellyfish

Undetermined species:

- (1) 2 cm diameter, orally-aborally flattened, outer edge and numerous short tentacles bright blue;
- (2) 2 cm diameter, globular, clear except for a brown ring about one cm in depth around the centre;
- (3) 5 cm long, elongate somewhat along the oral-aboral axis, seemingly with four pendant lappets.

Class Anthozoa

Subclass Alcyonaria (=Octocorallia)

Order Coenothecalia

Heliopora coerulea

Order Alcyonacea—soft corals

Lobularia pachyclades

Order Stolonifera

Tubipora musica — organ-pipe coral

Subclass Zoantharia (=Hexacorallia)

Order Actiniaria — sea anemones

Anemonia (?)

⁴Classification after Chuang (1961) with some exceptions.

Stoichactis sp — associated with the clown fish *Amphiprion*

Order Madreporaria — stony corals

Acropora concinna — stag's horn coral

A. brueggemani — stag's horn coral

A. tubicinaria — stag's horn coral

A. variabilis — stag's horn coral

Diploastrea heliopora

Favites abdita

Fungia actiniformis — mushroom coral

F. fungites — mushroom coral

Galaxea fascicularis

Leptoria phrygia — brain coral

Montipora striata

Pocillipora damicornis

P. verrucosa

Porites nigrescens

Psammocora contigua

P. togianensis

Tubastrea aurea

T. diaphana

PHYLUM NEMATODA — roundworms

Numerous individuals of several species were observed among rocks and coral but none could be identified.

PHYLUM ANNELIDA — segmented worms

Class Chaetopoda

Order Polychaeta

Family Nereidae

Three unidentified species

Family Leodocidae

Two unidentified species

Family Serpulidae

Two unidentified species

PHYLUM ARTHROPODA

Class Crustacea

Subclass Malacostraca

Order Stomatopoda

Family Squillidae

Squilla sp

Order Decapoda

Family Penaeidae — prawns

Family Synalpheidae — snapping prawns

Suborder Brachyura
 Family Maiidae
Camposcia retusa

Class Insecta

Order Hemiptera
 Water-strider-like individuals on the surface of calm water.

PHYLUM MOLLUSCA

Class Cephalopoda

Order Decapoda — squid and cuttlefish
 Family Sepiidae — cuttlefish
Sepia esculenta

Order Octopoda
 Family Octopodidae — octopuses
Octopus sp

Class Lamellibranchia (=Pelecypoda, Bivalvia)

Order Taxodonta
 Family Arcidae
Barbatia bicolorata

Order Heterodonta
 Family Tridacnidae
Hippopus hippopus
Tridacna crocea
T. noae
T. squamosa

Class Gastropoda

Order Archaeogastropoda
 Family Turbinidae
Astrea stellata — star shell
Turbo intercostalis — turban shell
T. marmoratus — green turban

Family Haliotidae — ear shells
Haliotis ruber — abalone

Family Neritidae
Nerita chamaeleon

Family Trochidae — top shells
Trochus gibberula — button shell
T. niloticus
Umbonium vestiarum

Order Mesogastropoda
 Family Cerithiidae — creeper shells
Cerithium patulum

Family Cypraeidae — cowries

Cypraea arabica — arab cowrie

C. carneola

C. isabella

C. lynx — lynx cowrie

Family Potamididae

Cerithidea quadrata

Family Strombidae

Lambis chiragra — spider conch

Order Neogastropoda

Family Conidae — cone shells

Conus ebraeus — Hebrew cone

C. marmoreus — marble cone

C. miles — soldier cone

C. pennaceus

C. striatus

C. textile — textile cone

Subclass Opisthobranchia

Order Nudibranchia

Undetermined species:

- (1) white dorid with black circles scattered over body, 2.5 cm long;
- (2) blue-grey with orange-tipped black ceratae, 4-5 cm long.

PHYLUM ECHINODERMATA

Class Ophiuroidea — brittle stars

Macrophiothrix longipeda

Ophiolepis superba

Class Asteroidea — star fish

Acanthaster planci — crown of thorns

Class Holothuroidea — sea cucumbers

Holothuria atra

Undetermined species:

- (1) black with four rows of yellow-tipped papillae, distinct flattened bivium with tube feet, 30 cm long;
- (2) white with orange markings, 30 cm long.

Class Echinoidea — sea urchins

Centrechinus setosus

Undetermined species:

- (1) test 9 cm diameter, subspherical (flattened orally-aborally), long thick black and white spines (some white banded with

purple) and fine, shorter black ones, all with barbs directed toward the spine's tip;

(2) predominantly white, 9 cm diameter.

PHYLUM CHORDATA

Subphylum Urochordata (=Tunicata)

Class Ascidiacea — sea squirts

One green compound species not identified.

Subphylum Vertebrata

Class Reptilia

Large sea turtle, probably *Chelonia mydas*.

Class Pisces — fish (Families observed are listed and, where possible, more specific identification is given. This does not mean the listed species were necessarily the only representatives of the family observed.)

Acanthuridae — surgeonfish

Balistidae — triggerfish

Blenniidae — blennies

Carangidae — horse-mackerels

Chaetodontidae — butterfly fish

Chaetodon (auriga or octofasciatus)

Chelmo(n) rostratus

Cottidae

Synanceja horrida — devilfish or stonefish

Diodontidae — porcupinefish

Dion holacanthus

Gobidae — gobies

Periophthalmus sp

Labridae — wrasses

Labroides dimidiatus (cleaning behaviour observed)

Monacanthidae — filefish

Muraenidae — moray eels

Pomacentridae — damselfish, clownfish, sergeant major

Abudefduf saxatilis

Amphiprion percula — clownfish (lives among the tentacles of the large sea anemone *Stoichactis*)

An unidentified black and white striped species of anemone fish.

Pomacanthidae — marine angelfish

Heniochus acuminatus

Pseudochromidae

Scaridae — parrotfish

Scarcus sp

- Serranidae — groupers
Epinephelus sp
 Synodontidae — lizard fish
 Tetraodontidae — pufferfish

APPENDIX I—RESULTS OF CORAL EXAMINATION

(by Ellin Doyle and Howard Takata)

Stag's horn corals provide a topic for investigation that could keep any biologist busy for many months. Encrusted on the surface of the coral, among the branches, and even burrowed inside, an amazing variety of animals and plants find that the coral (even though it may be dead) fulfills some requirement for survival.

Procedure for this investigation was quite simple. A dead stag's horn coral of approximately 6800 c.c. volume was brought up from a depth of about 5 m from the study area off Pulau Aur. Shortly thereafter the coral was methodically broken into pieces and the living plants and animals observed were extracted and preserved for future identification. Detailed microscopic investigation was not made.

Plants were few in number, consisting mostly of red and orange coralline algae and a few small green and red algae. Fauna is listed below.

PORIFERA—*Cliona* sp—numerous

Other Demospongiae—two unidentified specimens of different species, one spherical, one tubular.

COELENTERATA—Hydrozoa: *Pennaria*—8 colonies

Plumularia—1 colony

Anthozoa: 16 small, unidentified individuals, one cm in diameter with many red tentacles; 7 stalks of a small branched red coral; an encrusting green coral.

NEMATODA—numerous

ANNELIDA—Polychaeta: Nereidae—9 specimens of three species

Leodocidae—three specimens of two species

ARTHROPODA—Crustacea: *Camposicia retusa*—two young individuals

Squilla sp—two individuals each 1.5 cm long

Synalpheidae—6 individuals, each 1.5 cm long

Penaeidae—three individuals, each 1.5 cm long.
 Three specimens of two other species of crab.

MOLLUSCA—Cephalopoda: *Octopus* sp—one individual

Gastropoda: *Turbo intercostalis*—one young snail, 2-4 mm.
long

Nerita sp—one individual, 2-4 mm long

One small white nudibranch.

ECHINODERMATA—Ophiuroidea: *Macrophiothrix longipeda* (?)— 2 small individuals.

CHORDATA—Urochordata: 25 individuals of a green compound tunicate

Vertebrata: two small fish.

So many organisms living in such close proximity inevitably interact, and a description of these interrelationships and the niche of each species constitutes the work of an experienced ecologist. It would be an interesting study requiring more careful observation and collection, but this investigation has given us some idea of the composition of a coral community.

REFERENCES

- ABBOTT, R.T., 1962. *Sea shells of the world*. New York: Golden Press.
- CHUANG, SHOU-HWA, 1961. *On Malayan shores*. Singapore: Muwu Shosa.
- DALTON, H.G., 1928. A visit to some islands off the east coast of Johore and Pahang. *J. Malayan Branch Royal Asiatic Soc.* 6: 78-96.
- HVASS, HANS, 1965. *Fishes of the world*. London: Methuen and Co.
- MARCHETTE, N.J., 1964. Notes on some flowering plants of Pulau Aur. *Malay. Nat. J.* 18: 50-59.
- ROTHSCHILD, LORD, 1961. *A classification of living animals*. London: Longmans.
- TWEEDIE, M.W.F. AND HARRISON, J.L., 1965. *Malayan animal life*, second edition. Hong Kong: Longmans.

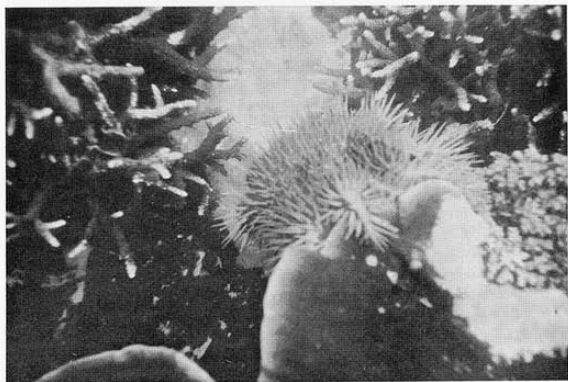


PLATE 23a. Crown of thorns starfish, *Acanthaster planci*, among coral.

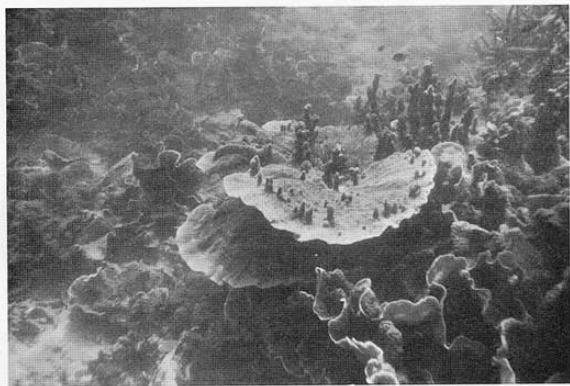


PLATE 23b. The sea urchin *Centrechinus setosus* in the center of the largest coral surface.

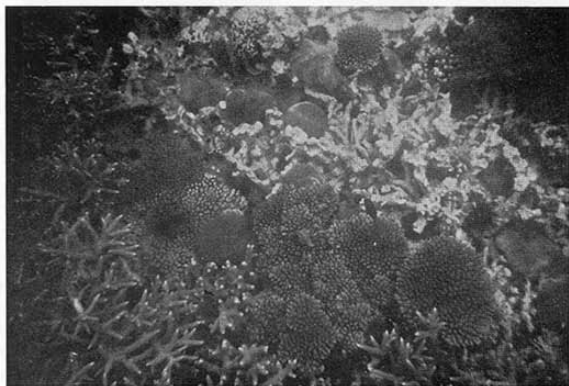


PLATE 24a. A typical shallow-water coral reef assemblage, the main component of which is stag's horn coral (*Acropora* spp).



PLATE 24b. A bed of coral, predominantly *Acropora* spp, in the center of which is a sea anemone, *Stoichactis*, with an anemone fish, *Amphiprion percula*, among its tentacles.