

## ARE THE CORAL REEFS ALONG THE COAST OF WEST SUMATRA SERIOUSLY DAMAGED ?

Andreas Kunzmann and Yempita Efendi

*Fisheries Faculty, Bung Hatta University,  
Jl. Sumatra, Ulak Karang, Padang 25114, Sumatra Barat, Indonesia.*

### ABSTRACT

Research on the condition of coral reefs along the coastline of West Sumatra is carried out since October 1992 using standard methods like manta-tow and line-transect. The key area investigated at a radius of 30 nm around Padang city comprises almost 5000 km<sup>2</sup> and about 86 reefs and small islands. In total 102 locations at 42 islands/reefs were investigated, including the Tanahmasa and some of the Mentawai islands. The results indicate that about 74 % of all investigated locations are seriously damaged (percentage cover (PC) with life coral; PC = 0 - 24%), about 22% of the locations are moderately damaged (PC = 25-49%) and only 3.7% of the locations are in good or very good conditions. Comparative studies indicate that most of the damage is caused by fishing with destructive methods, about all blast-fishing. It is recommended that the provincial and central government react fast by strictly enforcing the existing laws and at the same time select areas for protection.

### INTRODUCTION

The International Union for the Conservation of Nature (IUCN) has earmarked coral reefs as typical tropical ecosystems, which need to be protected. This is because of their significance for the marine ecosystems in general and for the resources exploited by humans in particular. Coral reefs serve as coastal protection devices, as tourist attractions, and above all as biotope food source for fish and other marine organisms.

Coral reefs are sensitive to environmental changes caused by human activities. In Indonesia the reefs in general are under heavy pressure because of overexploitation, so that most reef areas are endangered (Djonlie 1993). This even caused Minister Sarwono (1993) to comment that from all marine and coastal systems in Indonesia, the coral reefs are the most damaged ones.

According to Djonlie (1993) there are three main human factors causing the coral damage in Indonesia; commercial and recreational activities, fishing and coral collecting activities; and pollution. Furthermore Sarwono (1993) stated that the main reason for the damage is because fishermen use explosives for fishing.

West Sumatra, facing the Indian Ocean between 0° 10' N and 3° S, with an approximate coastline of about 240 nm, includes about  $3.2 \times 10^6$  km<sup>2</sup> of territorial waters (12 nm border) and about  $5.8 \times 10^6$  km<sup>2</sup> of EEZ (200 nm range). The capital Padang has about 700,000 inhabitants and all households and settlements discharge their waste straight into the sea, either directly or via three main rivers. Additional sources of pollution are Teluk Bayur, a big commercial port and Bungus, a big fishing harbour, both located in the south. In Bungus Bay a plywood factory and an oil pier of Pertamina have been demonstrated to give negative impact on corals (Nusyirwan 1994).

Logging and mining activities in the mountains fill the rivers with eroded soil and heavy metals. The sediment and pollution load of all West Sumatra rivers are discharged into the Indian Ocean. Finally around 10,000 fishermen, with about 4,500 fishermen from Padang city alone, are operating in the coastal waters with mainly small scale and medium scale gears (Dinas Perikanan 1992). Moreover foreign fishing fleets and fishermen from North Sumatra, still illegally using trawls, place a heavy pressure on marine life.



West Sumatra fishermen also use explosives and poison (Kunzmann *et al.* 1993) and when local and national newspapers published several articles on this matter, the provincial government reissued a decree reminding that fishing with explosives and poison is illegal (Governor Decision 1993). Due to the above mentioned broad range of human activities, which particularly affect vast areas of the coral reefs closest to Padang, an intensive investigation was started to be carried out using rapid assessment methods.

The main objectives of this study were:

- 1) to know about the general situation of the coral reefs of West Sumatra,
- 2) to get an indication which factors are the main causes for the coral reef degradation,
- 3) to come up with recommendations for the provincial government for immediate actions,
- 4) to establish a basic database for future more detailed and more specific investigations.

The hypothesis intended to be tested was that *most damaged reefs will be found close to the coast, rivers and settlements.*

## MATERIALS AND METHOD

The research was carried out from October 1992 to November 1994 in the waters off West Sumatra Province, focusing on an area of about 30 nm around Padang, but also including the equator islands on the border to North Sumatra (Pini and Tanahmasa archipelago) and the Mentawai Islands (Figure 1).

The reef survey methods used, such as line-transect (Plate 1a), visual census, manta tow, area grid and video shots are described in great detail in UNESCO (1984), UNEP (1993) and English *et al.* (1994). In addition data on water quality and mass occurrence of *Acanthaster* starfish and *Diadema* sea urchin were collected. Moreover the distance to the coast and the distance to the next large river was recorded for all locations.

The main indicators secured during the fieldwork were the percentage cover (PC) with life coral and the coral and fish diversity. For fish diversity some key fish species like butterfly fishes (*Chaetodontidae*) and angel fishes (*Pomacanthidae*) were selected.

Besides the usual standard skin and scuba diving equipment and 12 and 15 l tanks, the following equipments were used for collecting data: aluminium and PVC report boards with common pencils, band meter (50 m), 1 m<sup>2</sup> steel area grids, Nikonos V camera with 35 mm and 15 mm lenses, SB-103 and Y 300 TTL flashlights, Sony Video Hi8 TR705 camera with an Amphibico underwater case and Marinsolar halogen lamps. Additional halogen spots were used to improve light conditions. For large distance surveys an UWscooter Aquazepp was used. Aluminium dinghies with outboard engine and a 16 m wooden cutter served for transport to and from the islands. For the water quality analyses the following equipments were used: Secchi disc, Hydrobios water sampler, sediment traps, refractometer and microsensors from WTW, and Knick for temperature, pH, oxygen and conductivity.

For assessment of the gross reef condition the following literatures were used: Anonymous (1984, 1989); Aziz *et al.* (1989), De Silva (1984), De Silva and Smith (1980), Kenchington and Hudson (1984), King (1988), Munro (1983, 1984); Parrish (1979), Prawoto *et al.* (1992, 1993); Schuhmacher (1976), Sluiter (1890), Soekarno (1989), Soemodihardjo (1986), Tay and Khao (1980), UNESCO (1984), Umbgrove (1930), Usher (1984), and White (1987, 1988).

For identification of single coral species or genera (character species) the following literatures were used: Allen and Steene (1994), Ditlev (1980), Hong and Sasekumar (1980), Scott (1984), UNESCO (1985) and Veron (1988).



For identification of fish species, mainly Kuitert (1992), Randall *et al.* (1990) and Wheeler (1985) were consulted.

In total 102 locations from 42 islands/reefs were investigated, including 76 individual transects, 40, manta tows and more than 50 hours Scuba diving.

## RESULTS

The results of line transects for 27 selected locations along the coast of West Sumatra are shown in Table 1. The calculated percentage cover (PC) with life corals rarely exceeds 50 %. Most of the investigated locations are virtually dead and a random line transect yields 0 % PC. These findings are confirmed by the manta tows, which are usually carried out before spots for transects are selected.

Sukarno (1993) proposed four levels for the description of coral reef conditions, based on the percentage cover. Using his levels about 74 % of all investigated locations of the present study are seriously damaged (percentage cover with life coral; PC = 0 - 24 %), about 22 % of the locations are moderately damaged (PC = 25 - 49 %) and only 3.7 % of the locations are in good or very good condition. Only one single island, Pulau Pieh, has a PC of more than 70 % for all selected locations.

Additionally the following observations can be summarized:

- 1) all dive spots show a high sedimentation rate. Some reefs are close to be totally covered by sediment, especially those to the south of Padang and those with a flat reef slope. Even at reefs with steep slope, sediment covers some corals. Only vertical reef walls are free of sediment;
- 2) all islands and especially the reefs not attached to islands show signs of fishing activities. A considerable number of reefs show a high level of destruction. A few reefs are totally destroyed. Some of the totally destroyed reef parts (e.g. Nyamuk, Sinyaru West) are beginning to be overgrown by algae (Plate 1b);
- 3) the characteristic marks of the use of explosives in fishing are present at many locations. At very few locations the density of destruction is covering a huge area, so individual bomb craters cannot be detected anymore. The highest level of destruction through dynamite was found at the diving spots at Siberut and Tanahbala (Mentawai's). The highest level of destruction by other fishing gear (and probably explosives) was found at Pulau Nyamuk;
- 4) reef fishes are still present in almost all locations which were investigated. However, the fish diversity is clearly increased at reefs which are still in good or excellent condition. Particularly the high number of butterfly and angelfishes indicates almost intact reef systems;
- 5) Pieh island as a whole, at a distance of 17.5 miles to the northwest of Padang city is one island, where inner and outer reefs are still in good to excellent condition (Plates 1c and 1d);
- 6) the vertical water visibility close to the coast rarely exceeds 5 to 7 meters. Only at islands of more than 15 miles distance to the coast the visibility exceeds 22 m. The data on physical water parameters indicate low pH, salinity and oxygen values close to the rivers, harbours and the plywood factory;
- 7) some locations, although close to a river mouth or a harbour, show a comparatively high percentage cover. Also the coral species diversity is high and the individual colony size is above average.

## CONCLUSIONS

The investigated locations can be grouped into three categories, i.e.:

- 1) islands/reefs with less than seven nm distance to the coast, where visibility is low, and the percentage cover, coral species diversity and individual colony size are comparatively high;



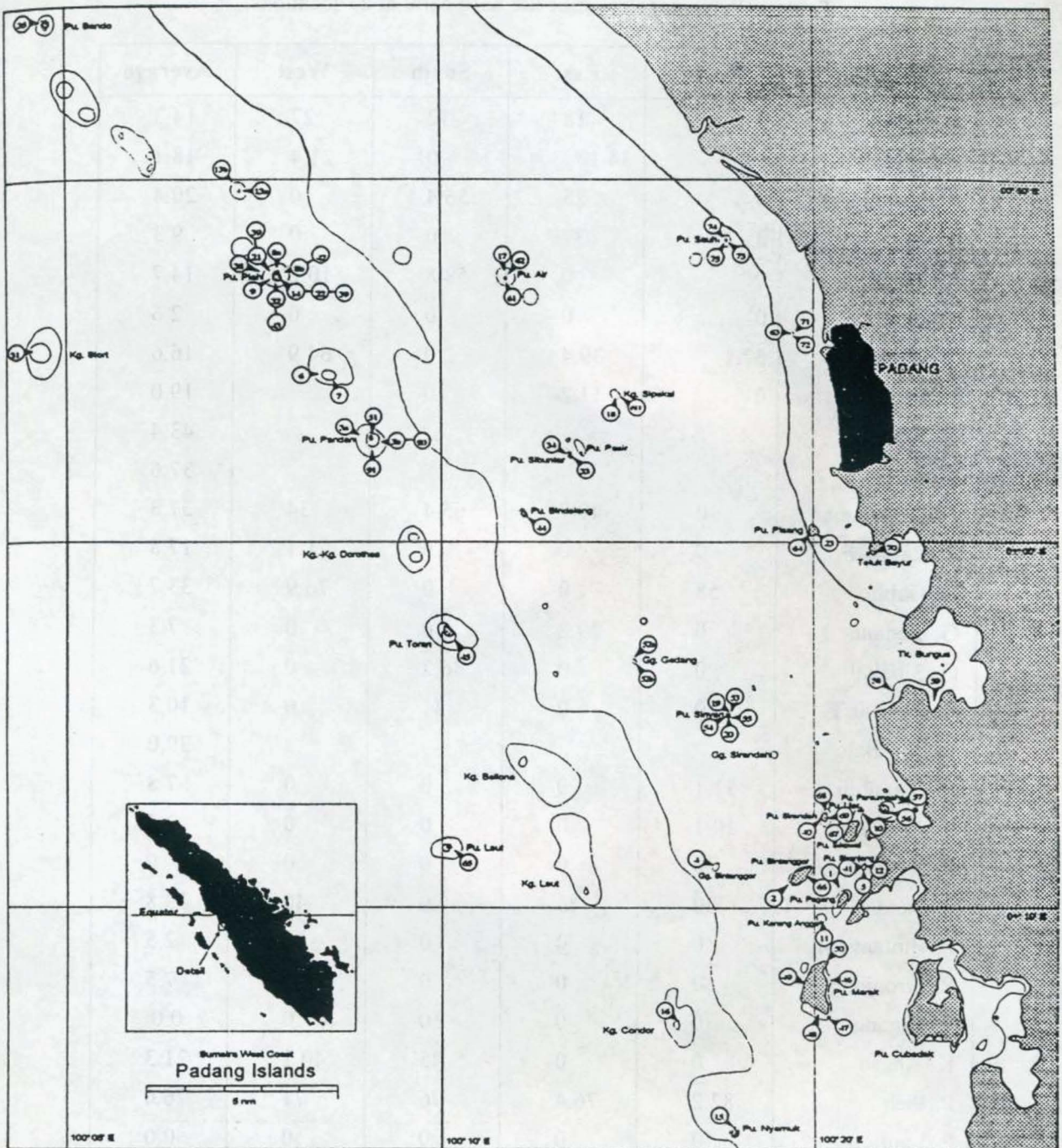


Figure 1. Research locations within 35 miles of Padang. The Mentawai Islands and some locations in the north are not included.



Table 1. Percentage cover of life hard coral at 27 locations.

Location	North	East	South	West	Average
P. Marak	0	18	12	27	14.3
P. Sinyaru	17	34.1	0	21.4	18.1
P. Pasumpahan	0	25	56.4	0	20.4
P. Air	0	37	0	0	9.3
P. Pisang	0	0	58.8	10.2	14.7
P. Kasik	0	0	0	0	2.6
P. Sirandah	37.1	39.4	0	64.9	16.6
P. Sauh	0	11.2	0		19.0
U. Nibung					43.4
T. Buo					37.6
P.U. Pariaman	0	49.7	65.4	34	37.3
P. Karsik P.	0	0	0	71.1	17.8
G. Gabuo	58	0	0	76.9	33.7
G. Gedang	0	29.2	0	0	7.3
G. Sipakal	0	0	86.2	0	21.6
G. Sibarat T.	0	0	41	0	10.3
P. Pini Bajo					39.0
P. Ular Pini	31.1	0	0	0	7.8
P. Anso Pini	10.1	0	0	0	2.5
P. Nyamuk	0	0	0	0	0
P. Pandan	50	45	0	40	33.8
P. Bintanggor	0	0	0	10	2.5
P. Sironjong	0	0	0	30	7.5
P. Pagang	0	0	0	0	0.0
K. Angso	0	0	45	40.1	21.3
P. Pieh	82.2	76.4	76	71	76.6
P. Laut	0	0	0	0	0.0

2) islands/reefs at a distance of seven to fifteen nm to the coast, where visibility is already high, the percentage cover, however, is low, but the species diversity low to moderate and the individual colonies have moderate size ;

3) islands/reefs at more than 15 nm distance to the coast, where visibility is excellent, but most locations have only very few hard corals with some places being totally destroyed (with very few exceptions).

The islands close to the coast are under pressure by pollution and sediment load of the rivers and harbours. This does, however, not necessarily seriously affect hard corals. In contrast, some of the biggest specimens



of *Porites* species were found here. Also the highest number of coral genera was found here (with the exception of Pieh island).

The islands far away obviously are less influenced by river discharge, as is also indicated by the data on visibility and physical water parameters. Most of the heavily destroyed locations, however, are found here. This is clearly a result of the fishing activities with explosives and poisons, as can be seen from many craters and wiped out areas. A possible explanation, why this only happens at islands out of visual range from the coast, is that less small scale fishermen are usually found out there and that it is much easier to escape unnoticed for those applying illegal fishing methods.

Finally it is concluded that the coral reefs along the coast of West Sumatra are indeed seriously damaged and the few remaining reefs, which are still in good condition, are endangered.

### RECOMMENDATIONS TO THE GOVERNMENT

It is strongly recommended to completely protect Pieh Island. Regulations and limits to fishermen, community and tourism should be setup. Research permits should only be given to experienced researchers. The establishment of a marine park and/or reserve (White 1987, 1988) in the long run is highly recommended. According to White (1988) Indonesia has a few marine parks already, most of them located on Java or eastern Indonesian islands. Only one is located in Sumatra, at Pulau Weh in the very north of Sumatra (Aceh). West Sumatra, with a still very high diversity in coral taxa would be an ideal location for an additional marine park.

A three step plan is proposed (see Kunzmann and Farouk 1994 for details) for actions to be taken:

- 1) total protection of Pulau Pieh (including the ban of collecting turtle eggs. In order to speed up, Bung Hatta University will buy the right to use the land and to establish a small field station with a resident guard;
- 2) the 20 nm islands should be included in the near future, in order to provide recovering areas (pearl : Bando, Pandan, Toran, Laut);
- 3) establish a marine park in cooperation with the responsible government and NGO bodies of Indonesia, like LH, PHPA, WALHI and WWF;

It is necessary that more detailed investigations, particularly into the sediment and pollution contents are carried out soon. Also a detailed taxonomic description of the hard corals occurring in this area should be undertaken soon. Finally data on physical oceanography on a small scale are still missing.

### ACKNOWLEDGEMENTS

The research team of the Center for Fisheries Development Studies of Bung Hatta University was supported by the crew of KM Fapen and by German and Indonesian students preparing their theses. Funds for this research were received from German Technical Cooperation (GTZ), from Center for Tropical Marine Ecology (ZMT), from the Governor of West Sumatra and from the Bung Hatta University. Our sincere thanks go to them all.

### REFERENCES

- Allen, G.R. and R. Steene 1994. Indo-Pacific coral reef field guide. *Tropical Reef Res.*, Singapore: 378 p.
- Anonymous 1989 Coral Reef. *Neth. J. Sea Res.* 23(2): 83-240.
- Anonymous 1984. Coral Reefs (Collection of Papers). *ICLARM Newsl.* 7: 1-32.



- Aziz, A., Kastoro, I. Aswandy, M. Adrim and M.H. Azkab 1989. Panduan Wisata Bahari: Pulau Genteng dan sekitarnya. LIPI-PPPO, Penelitian dan Pengembangan Sumberdaya Laut, Jakarta, 42 p.
- De Silva, M.W.R.N. 1984 Review of some coral reef assessment methods commonly used in Southeast Asia, the Pacific and elsewhere. In: UNESCO (ed.), Comparing coral reef survey methods, *UNESCO Rep. Mar. Sci.* 21: 47-56.
- De Silva, M.W.R.N., and R.A. Smith 1980. Coral reef resources of the east coast of peninsula Malaysia. In: Chua Thia Eng; J.K. Charles, (eds). Coastal resources of East coast peninsula Malaysia. Univ. Sains, Kuala Lumpur : 95-158.
- Dinas Perikanan 1992. Buku tahunan statistik perikanan tingkat Propinsi. Pem. Prop. Dati I Sumatera Barat, Dinas Perikanan, Padang : 95 p.
- Ditlev, H. 1980. A field guide to the reef-building corals of the Indo-Pacific. Backhuys, Rotterdam : 291 p.
- Djonlie, W.E. 1993. Koresponden antara ekoregion dan pola sebaran komunitas terumbu karang di Pulau Bunaken. Tesis Progr. Pascasarjana, Institut Pertanian Bogor, Bogor : 65 p.
- English, S., C. Wilkinson and V. Baker (eds.) 1994. Survey manual for tropical marine resources. AIMS, Townsville: 368 p.
- Governor Decision 1993 No. 04/ISNT/GSB/1993, Padang: 2 p.
- Hong, G., A. Sasekumar 1980. The community structure of the fringing coral reef, Cape Rachado. *Malay. Nat. J.* 34: 25-37.
- Kenchington, R.A. and B.E.T. Hudson (eds.) 1984. Coral reef management handbook. UNESCO, Jakarta: 281 p.
- King, M. 1988. Coral reefs in the South Pacific. South Pacific Commission, Noumea: 40 p.
- Kuiter, R.H. 1992. Tropical reef fishes of the Western Pacific Indonesia and adjacent waters. PT Gramedia, Jakarta: 314 p.
- Kunzmann, A. and Farouk 1994. Konservasi alam dan Taman Laut Pieh. Pusat Studi Pengemb. Perik. Padang: 5 p.
- Kunzmann, A., Zimmermann, C. and Y. Efendi. 1993. Are the coral reefs in the vicinity of Padang city endangered by pollution and fishing with explosives ?, Bung Hatta Univ. Padang: 8 p. (presented in German language at the "7. Jahrestagung der GTO") Bremen, 17. 20.2.1994).
- Munro, J.L. 1983. Caribbean coral reef fishery resources. *ICLARM Studies and Reviews* 7 : 1- 276.
- Munro, J.L. 1984. Coral reef fisheries and world fish production. *ICLARM Newsl.* 7 : 3-4.
- Nusyirwan 1994. Pengaruh pembuangan limbah wood factory Bungus terhadap kehidupan terumbu karang di perairan Bungus Teluk Kabung, Padang, Thesis SI, Bung Hatta Univ., Padang : 68 p.
- Parrish, I.D. 1979. Fishes at a Puerto Rican coral reef: distribution, behaviour and response to passive fishing gear. *Proc. Assoc. Isl. Mar. Lab. Carrib.* 14 : 20 p.
- Prawoto, S., Soeharsono, M. Adrim, Hadikusumah, W. Kiswara, Subardi, Sriyono and A. Ibrahim 1992. Wisata Bahari Teluk Lampung. PPPO-LIPI, Proyek Penel. Pengemb. Sumberdaya Laut, Jakarta : 19 p.
- Prawoto, S. Soeharsono, M. Adrim, Mudjiono, I. Suryana, Subardi, and A. Ibrahim 1993. Wisata Bahari Pulau Belitung. PPPO-LIPI, Proyek Penel. dan Pengemb. Sumberdaya Laut, Jakarta : 97 p.



- Randall, J. E., Allen, G.R. and R.C. Steene 1990. *Fishes of the Great Barrier Reef and Coral Sea*. Grawford House Press, Bathurst : 507 p.
- Sarwono, K. 1993. *Terumbu karang yang paling terancam*. Harian Umum Kompas, 2 September 1993, Padan : 1 p.
- Schuhmacher, H. 1976. *Korallenriffe*. BLV, Munchen : 275 p.
- Scott, P.J. 1984. *The corals of Hongkong*. Hongkong Univ. Press, Hongkong : 112 p.
- Sluiter, C.P. 1890. Einiges uber die Entstehung der Korallenriffe in der Javasee und Brantweinsbai, und uber neue Korallenbildung bei Krakatau. *Natuurkundig Tijdschrift voor Nederlandsch Indie*, Batavia : 360-380.
- Soekarno, R. 1989. Comparative studies on the status of Indonesian coral reefs. *Neth. J. Sea. Res.* 23: 215-222.
- Sukarno 1993. Mengenal ekosistem terumbu karang. Materi pelatihan metodologi penelitian penentuan kondisi terumbu karang. Puslitbang Oseanologi-LIPI, Jakarta : 96 p.
- Soemodihardjo, S. (ed.) 1986. Proc. of MAB-COMAR Regional Workshop on Coral Reef Ecosystems. UNESCO/LIPI, Jakarta: 151 p.
- Tay, S.W., H.W. Khao 1980. The distribution of coralreef fishes at Pulau Salu, Singapore. unpubl., Biotrop Sympos.: 13 p.
- Umbgrove, J.H.F. 1930. The end of Sluiter's coral reef at Krakatoa. *Leidsche Geol. Med.*: 326-264.
- UNEP. 1993. Monitoring coral reefs for global change. Reference methods for marine pollution studies No.61.
- UNESCO 1984. Comparing coral reef survey methods. *UNESCO Rep. Marine Sci.* 21 : 1-170.
- UNESCO 1985. Coral taxonomy. Results and recommendations of a regional UNESCO (COMAR)/UNEP workshop with advanced training. *UNESCO Rep. Mar. Sci.* 33 : 142
- Usher, G.F. 1984. Coral reef invertebrates in Indonesia : their exploitation and conservation needs. *IUCN/WWF Report, Bogor* : 100 p.
- Veron, J.E.N. 1988. Corals of Australia and the Indo-Pacific. AIMS, Townsville : 656 p.
- Wheeler, A. 1985. *The world encyclopedia of fishes*. Macdonald, London : 368 p.
- White, A.T. 1987. Coral reefs : Valuable resources of Southeast Asia. *ICLARM Education Series 1* : 1-36.
- White, A.T. 1988. Marine parks and reserves : management for coastal environments in Southeast Asia. *ICLARM Education Series 2* : 1-36.



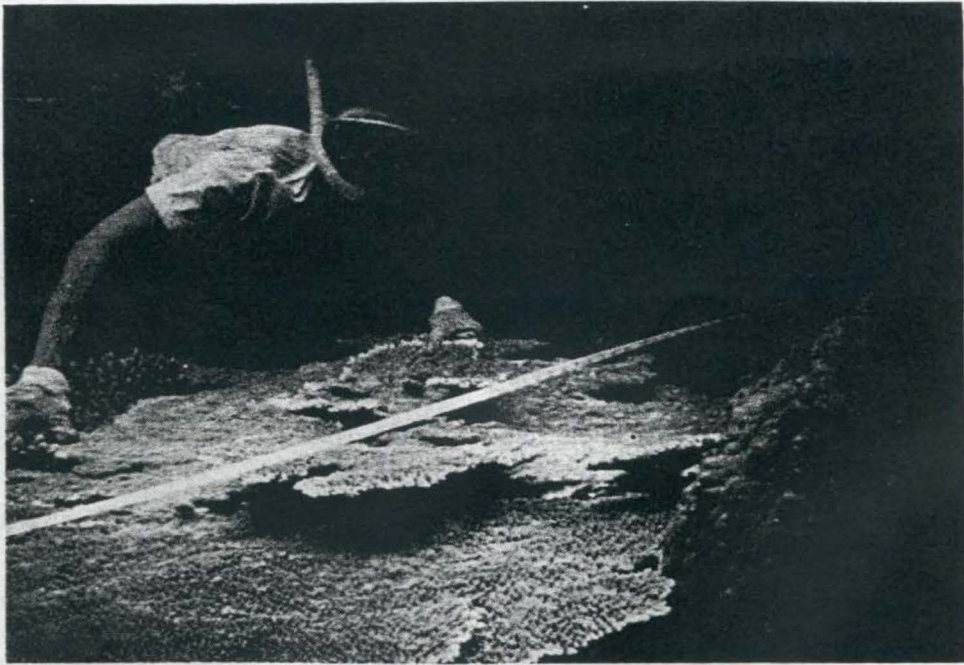


Plate 1. a. Skin diver reading the diameter of a tabulate *Acropora* species during a transect.

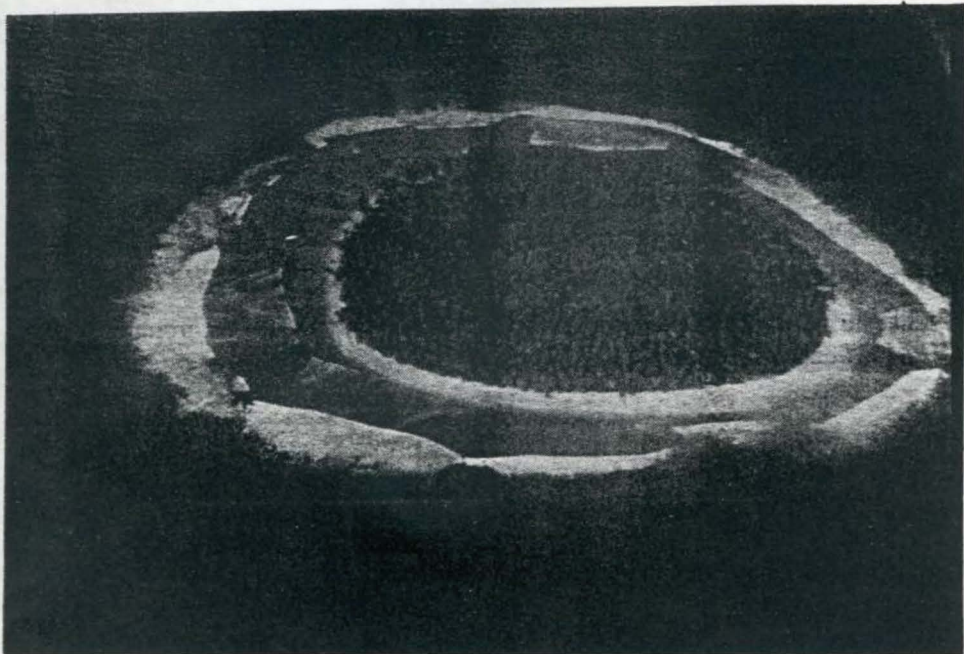


Plate 1. b. Air picture of Pulau Pieh, one of the Padang Island with coral reefs in excellent condition.





Plate 1. c. Dead reef slope at Pulau Nyamuk



Plate 1. d. Typical diversity of hermatypic coral species on a reef in good condition.