STATUS OF CORAL REEFS INFRONT OF UNIVERSITY MALAYSIA SABAH JETTY

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ABSTRACT

Coral reefs of Sabah are under serious threat due to destructive fishing such as dynamite and cyanide fishing that is widespread throughout the state waters. This paper presents the results of Reef Check and Line Intercept Transect surveys in font of UMS jetty. The general status of coral reefs in front of UMS jetty is in poor condition. The overall percentage of hard coral is 27 %. There were eight benthic categories of hard corals that were found at the study site and a total of two families of targeted fish were found at all stations. However, there were no targeted invertebrates recorded in the transects. Even though the reefs at the UMS jetty are in poor condition, there is some diversity of corals and other marine organisms. The reefs that are disturbed by human activities such as destructive fishing methods and near shore development have the potential to recover if proper measures are taken to ensure that these factors do not continuously affect the area.

ABSTRAK

Terumbu karang di Sabah dikatakan berada dalam tahap serius yang disebabkan oleh gangguan dari penangkapan ikan yang menggunakan bom dan racun dimana ia berlaku secara meluas di perairan Sabah. Kertas kerja ini menunjukkan data daripada hasil tinjauan menggunakan kaedah 'Reef Check' dan 'Line Intercept Transect' di kawasan berhampiran jeti UMS. Secara amnya status terumbu karang di kawasan UMS jeti adalah rendah. Secara keseluruhannya peratusan terumbu kanrang adalah 27 %. Terdapat lapan kategori bentos bagi karang di kawasan tinjauan ini dan sejumlah 2 famili ikan sasaran dijumpai bagi keseluruhan stesen. Walau bagaimanapun, tiada inveterbrata sasaran dijumpai dalam transek. Secara kesimpulannya, walaupun litupan terumbu di kawasan UMS ini berada dalam tahap yang rendah, terdapat juga sedikit kepelbagaian bagi karang dan organisma lain. Gangguan keatas terumbu tersebut hasil daripada penggunaan alat penangkapan yang boleh merosakkan terumbu karang dan pembanggunan persisiran pantai mempunyai potensi untuk dibaiki jika tindakan yang sewajarnya dilakukan dengan melakukan tinjauan yang berterusan bagi memastikan factor tersebut tidak mempengaruhi kawasan tersebut.

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LIST OF SYMBOLS

Ppt	Part per thousand
°C	Degree Celsius
%	Percentage
m	Meter

CHAPTER 1

INTRODUCTION

1.1 Introduction of study

Coral reefs of Sabah are under serious threat due to the destructive fishing methods such as dynamite and cyanide fishing that is widespread throughout the state waters (Oakley *et. al.*, 1999). The damage and deterioration of coral reefs are also caused by increased sedimentation and collection of the reef biota.

Due to the serious threats on coral reefs in Kota Kinabalu, one protected area or park was established by the Sabah State government in 1974 that comprised part of Pulau Gaya and the whole of Pulau Sapi. The boundary was extended to Pulau Manukan, Pulau Mamutik and Pulau Sulug in 1978. The Sabah Park Authority is the government agency that is responsible for the management and administration of the Park (Woodman and Wilson, 1994).

The study on the status of coral reefs was conducted at a small area in Sepanggar Bay, which is located not far from the Marine Protected Area of Pulau Gaya. Reef Check

(www.reefcheck.com) was conducted in this study as an attempt to assess the health of coral reefs at the study site.

The reefs at the study site are considered under intense pressure from human activities especially from the fishing methods such as blast fishing and through development from the construction of jetty and buildings. Based on the disturbances occuring in the study site, ongoing monitoring should be conducted to assess the effects of human activities in the area.

1.2 A Study site: a brief description

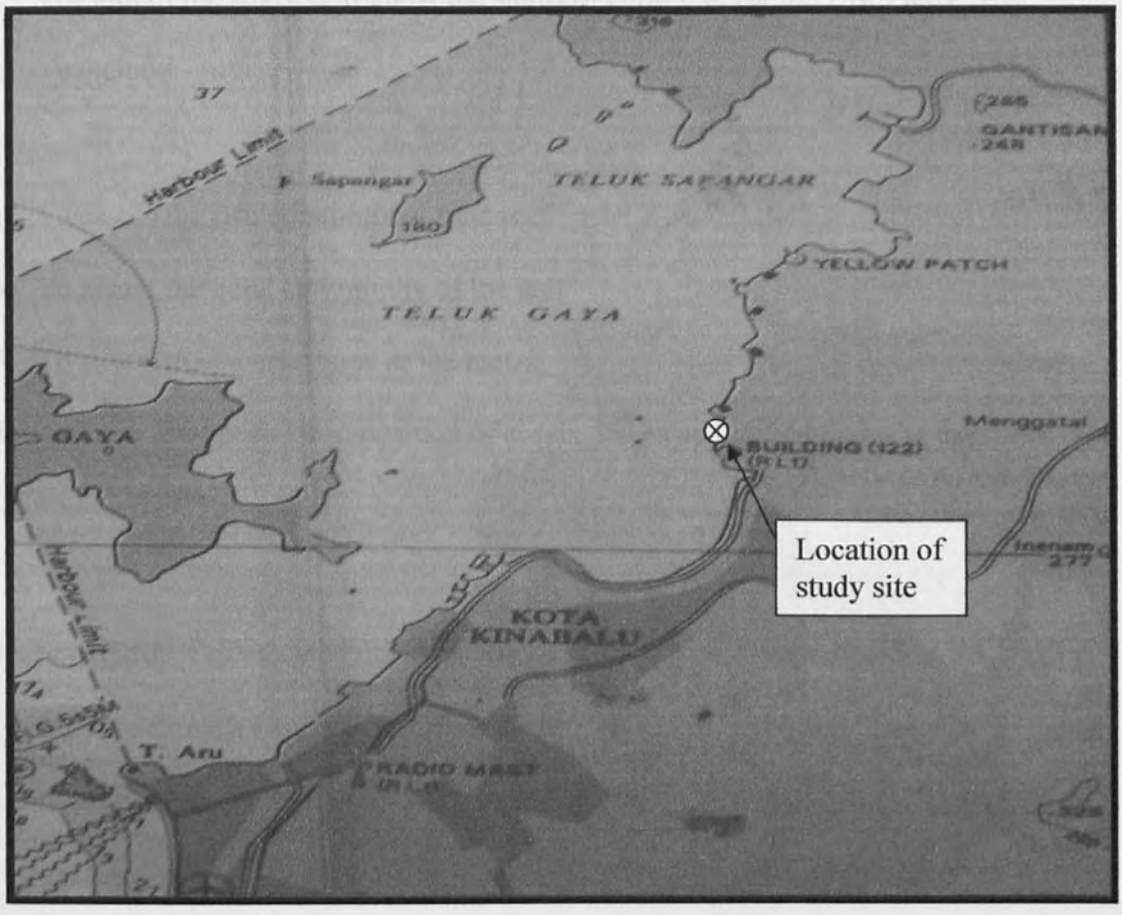

Figure 1.2 Map of study site at UMS jetty.

The study site is located by the UMS jetty, which is situated approximately 5 to 8 km northwest of Kota Kinabalu. Pulau Gaya is approximately 3 to 6 km in front of the UMS jetty. This area is exposed to many disturbances such as blast fishing, construction works, land reclamation and dredging. The area has not been surveyed previously.

1.3 Objective and significance of study

The aim of the study is to know the status of coral reefs at the UMS jetty. The objectives include:

a) To assess the fish community of the reef
b) To assess the coral community of the reef.
c) To assess the invertebrates of the reef.
d) To know the species composition of corals, fishes and invertebrates at the study site

The significance of this study is to determine the status of the coral reefs at the UMS jetty in order to create a baseline data. Previously, no studies have been conducted in the area, especially after the construction of the UMS jetty.

CHAPTER 2

LITERATURE REVIEW

2.1 Coral reef communities

A coral reef consist of corals, fishes, invertebrates, algae and others such as sponges, soft corals and gorgonians (Castro and Huber, 2003). These components play their own role in the ecosystem that has yet to be fully understood (Nybakken, 1997). In the reef ecosystem, interactions occur between the reef communities such as competition, predation and grazing (Castro and Huber, 2003). These interactions will result in increasing or decreasing of size of corals especially in numbers of corals and shaping the reefs through grazing by the fishes (Nybakken, 1997).

2.1.1 Corals

The basic reef structure is mainly formed by corals (Nybakken, 1997). However, not all reefs are formed by corals. Some reefs formed by marine plant such as crustose coralline algae and animals such as oyster, annelid worm tubes or even cyanobacteria (Sumich, 1999). Corals generally belong to the phylum cnidaria that is closely related to

sea anemones (Barnes and Hughes, 2003). They consists of fire corals, soft corals, horny corals, organ pipe corals, precious corals, red, blue or black corals and stony corals (Nyabakken, 1997)

The interactions among the corals are extremely complex. They compete for space and light among themselves to survive. Besides that they also compete for space and light with other marine plants such as algae. The predation on corals by fishes and invertebrates such as butterflyfish and crown-of-thorns can strongly affect the number and types of corals that live on the reef, hence predation is important in structuring a coral reef community (Castro and Huber, 2003).

2.1.2 Fishes

According to Alen and Steene (2002), 7000 out of 12 000 marine fishes can be found in coral reefs or nearby inshore habitats. The great varieties of habitat that occur on a reef is one of the reasons there is a high diversity of fish species on the reef.

Fishes in the reef area are important in structuring coral reef communities by grazing. The examples of some grazing fishes are surgeon fish (Acanthurus), parrotfish (Scarus) and damselfishes (Pomacentrus and Dascyllus). They are important because they feed on algae that can overgrow corals (Castro and Huber, 2003). Carnivorous fish that feed on crown-of-thorns are important in lowering the densities of the crown-of-thorns that feed on corals in the reef ecosystem. Fishes that feed on crown-of-thorns are

butterflyfish and triggerfish. They rely on coral reefs for shelter, getting food and breeding (Nybakken, 1997).

2.1.3 Invertebrates

At least 97 percent of all species of animals are invertebrates and many of the invertebrates have marine representatives (Castro and Huber, 2003). Each of them plays a different ecological role in the sea (Duxbury and Duxbury, 1993).

The common invertebrates that are usually seen on the reef are large echinoderms such as sea cucumbers, urchins and feather stars and large molluscs such as *Tridacna* (Nybakken, 1997). Some, especially sea urchins are important as a seaweed grazer to reduce the competition between seaweeds and corals (Castro and Huber, 2003).Small invertebrates such as snails, chitons, crustaceans and polychaete worms that eat algae also help to reduce the overgrown algae in the reef areas (Nybakken, 1997). However, not all invertebrates help corals to reduce the competition among reef communities. Invertebrates such as crown-of-thorns sea star feed on live corals tissues by pushing its stomach out through the mouth to cover the whole part of the coral colony. They consume almost any corals in their path (Castro and Huber, 2003).

2.1.4 Algae

The two major types of marine plants are seaweed and seagrass (Alen and Steene, 2002). Seaweeds are more commonly found in coral reefs area. They can be divided into three groups based on their pigments. The three groups are green algae (Chlorophyta), brown algae (phaeophyta) and red algae (Rhodophyta) (Duxbury and Duxbury, 1993).

Algae compete for space and light with corals and sessile invertebrates (Castro and Huber, 2003). They are major space competitor to corals but this does not happen because under natural condition they are kept in check by grazers and nutrient limitation. However, on the other hand algae are important reef builders especially the coralline red algae (Porolithon, Lithothamnion) because they can deposit calcium carbonate within their cell walls.

2.1.5 Others

There are also other organisms such as sponges and soft corals that can be commonly found and easily seen on reef areas (Castro and Huber, 2003).

Sponges have less complex body structures than other multi-celled creatures (Alen and Steene, 2002). They compete for space with corals on reefs areas. However, on the other hand they are important for other organism such as fish and invertebrate as a hiding place (Castro and Huber, 2003).

Soft corals such as sea anemones also compete for space with corals on reefs. They can kill hard corals that grow close to them by releasing defensive chemicals into the water. They also can move slowly to invade and occupy available space on the reef. They are important to fishes such as Anemonefishes. The anemonefishes are protected by the anemone's stinging tentacles and brood their eggs under the anemones (Nybakken, 1997).

2.2 Importance of reefs

Coral reefs are diverse and beautiful. They are important as the foundation and protection of thousands of islands. Coral reefs are also vital to many large islands and continental margins for the protection of land areas. They may provide subsistence, security and cultural utility to the inhabitants of communities in all coastal tropical nations (Kenchington and Hudson. 1984).

Coral reefs are important in protecting the coast from erosion or as natural breakwaters (Kenchington and Hudson. 1984). Coral species and reef formation exposed to storms and wave actions differ greatly from the sheltered areas. Massive coral forms such as encrusting colonies of *Porites* and the abundance of soft corals can be found in the exposed slopes and can withstand the pounding of wave action. The more delicate species such as *Acropora* branching tabulate and cabbage shapes can be found in sheltered areas (Salleh Mohd. Nor and Wan Portiah Hamzah, 1992).

Coral reefs are important to the marine fishes because fishes utilize the reefs as spawning and breeding grounds. Pelagic fishes also visit the reefs for feeding during migration. There are plenty of food and shelter for the free-swimming species and larger predators in the coral reefs areas (Mohd Nor, S. and W. P. Hamzah. 1992). The holes and crevices in the reef provide shelter for fishes and invertebrates and also to their juvenile stages (Kenchington and Hudson. 1984).

Coral reefs are important as fishing grounds. A survey of total fishery catch of Western Sabah indicated that reef fishes comprised almost one quarter of the total fish landing of Labuan and Kota Kinabalu (Mohd Nor, S. and W. P. Hamzah. 1992). Seasonal fisheries of pelagic migratory species such as tuna, mackerel and travellies are important catches around the reef environment. Fishes such as groupers, cods and emperors may be caught throughout the year but are rare in numbers (Kenchington and Hudson. 1984).

Coral reefs are vast storehouses of genetic information. The expression through medium of biocompounds with unique form and function from researchers and specialists show a wide range of biomedical characteristic including antibacterial, cardioactive, neurophysiologic, psychotropic and anticancer properties (Johnston, 1986).

Coral reefs are also important to the tourism industry. Snorkeling and diving are activities that have become more popular over the years in attracting tourist, which also contributes to the rise of foreign exchange (Johnston, 1986).

REFERENCES

Allen, G. R. and R. Steene. 2002. Indo-Pacific coral reef field guide. Published by Tropical reef research, 326 Upper Paya Lebar Road, #04-06 Da Jin Factory Bldg., Singapore 534963. 65-101p, 257-351p.

Allen, G. 1996. Marine life of Malaysia and Southeast Asia. Deriplus Edition (HK) Ltd, Singapore. 13-14p.

Barnes, R.S.K. and Hughes, R.N. 1988. An Introduction to Marine Ecology. 2th. Ed. Blackwell Science: Germany. 161-162p.

Bryant, D., Burke, L., McManus, J. and Spalding, M. 1998. Reef at Risk: A Map-based Indicator of Threats to The World's Coral Reefs. World Resources (WRI), USA. 8p,15p,10p.

Burgess, W.E. 1979. Corals. Published by T.F.H. Publication, Inc., 211 West Sylvania Avenue, P.O.Box 427, Neptune, NJ 07753, US. 26-47p

Castro, P. and M. E. Huber. 2003. Marine Biology. 4th· ed. McGraw-Hill, a business unit of the McGraw-Hill companies, Inc., 1221 Avenue of the Americas, NY 10020. 2-3p.

Duxbury, A.B. and A.C. Duxbury. 1993. Fundamentals of oceanography. Wm. C. Brown Communication, Inc., 2460 Kerper Boulevard, Dubuque, IA 52001, USA. 258-259p.

English, S., C. Wilkinson and V. Baker. 1997. Survey manual for tropical marine resources. Published on behalf of the ASEAN-Australia Marine Science Project: Living Resouces by the Australian Institute of Marine Science. P. M.B. No. 3 Townsville Mail Centre, Australia 4810. 5p.

Fazrullah Rizally B. Abd. Razak. 1997. Associate macroalgae with corals and seagrass beds of Tunku Abdul Rahman Park, Sabah, Malaysia. Thesis of bachelor science, University Putra Malaysia (not publish). 4-5p.

Garrison, T. 2002. Oceanography: An invitation to marine science. 4th . ed. Wadsworth group/ Thomson Learning, Inc., 511 Forest Lodge Road, Pacific Grove, CA 93950, USA. 427p.

Harding, S.P., Lowery, C., Colmer, M. and Oakley, S,G. 2001. A Preliminary Species Checklist Of Reef Fish for The Banggi Chanel, Pulau Banggi, Sabah. First Annual Report (July 1999-september 2000), Greenforce, UK. 10-11p.

Hill, j. and C. Wilkinson. 2004. Methods for ecological monitoring of coral reefs. version 1. Australian Institute of Marine Science. P. M.B. No. 3 Townsville Mail Centre, Australia 4810. 45-91p.

Hodgson, G., Kiene, W., Mihaly, J., Liebeler, J., Shuman, C., and Maun, L. 2004. Reef check instruction manual: A guide to reef check coral reef monitoring. Published by Reef Check, Institute of the environment, University of Califonia at Los Angeles. 7-8p, 85p.

Ho, S.L. 1992. Coral reef of Malaysia. Tropical Press Ltd., Kuala Lumpur. 17p.

Ingmanson, D.E. and W.J. Wallace. 1995. An introduction: Oceanography.5th .ed. Wadsworth publishing company, United States of America. 478p.

Johnston, N. A. 1986. The hard corals of Sabah. Universiti Kebangsaan Malaysia, Banggi, Malaysia. 10p.

Johnston, N. A. 1983. Coral reefs of Pulau Tiga, West Sabah. *Journal of Unit Biology*. 578-789p.

Kenchington, R.A. and B. E.T. Hudson. 1984. Coral reef management handbook. Published by Unesco Regional Office for Science and Technology for South-East Asia, JL Thamrin 14, Tromolpos 273/ JKT Jakarta, Indonesia. 9-27p.

Koh, L.L., Chou, L.M. and Tun, K.P.P. 2002. The status of coral reefs of Pulau Banggi and its vincinity, Sabah, Based on surveys in June 2002. National University of Singapore, Singapore. 28-33p.

Lassim, S. V. 1997. Perbandingan species dan taburan coral genus fungia di perairan Sabah dan Terrengganu. Disertasi Sarjana Sains, Universiti Putra Malaysia (tidak diterbitkan). 1-2p.

Lee, W and Chou, L.M. 2003. The status of coral reefs of Pulau Banggi and its vincinity, Sabah, Based on surveys in June 2003. National University of Singapore, Singapore. 24-29p.

Nyabakken, J. W. 1997. Marine biology an ecological approach. 4th. ed. Addison Wesley Longman, Inc, US. 338-337p.

Oakley et. al. 1999. Reef under attack: The status of coral reefs of Sabah, East Malaysia. Presented t 4th international conference on the marine biology of the south China sea, Quezon city, Philiphines. 1-2p.

Peter, D.S. 2002. Shells. Dorling Kindersley. USA. 69-73p.

Salleh Mohd Nor and Wan Portiah Hamzah. 1992. Marine Heritage of Malaysia. Jiwabaru Sdn. Bhd., Malaysia. 23-51p.

Sumich, J. L . 1999. An introduction to the biology of marine life. 7th .ed. McGraw-Hill Companies, Inc, NY. 272p.

Woodman, G. and S. Wilson. 1994. Changes to coral reef communities in the Tunku Abdul Rahman National Park, Sabah, Malaysia between 1987 and 1994. The Forge.UK. 20p.