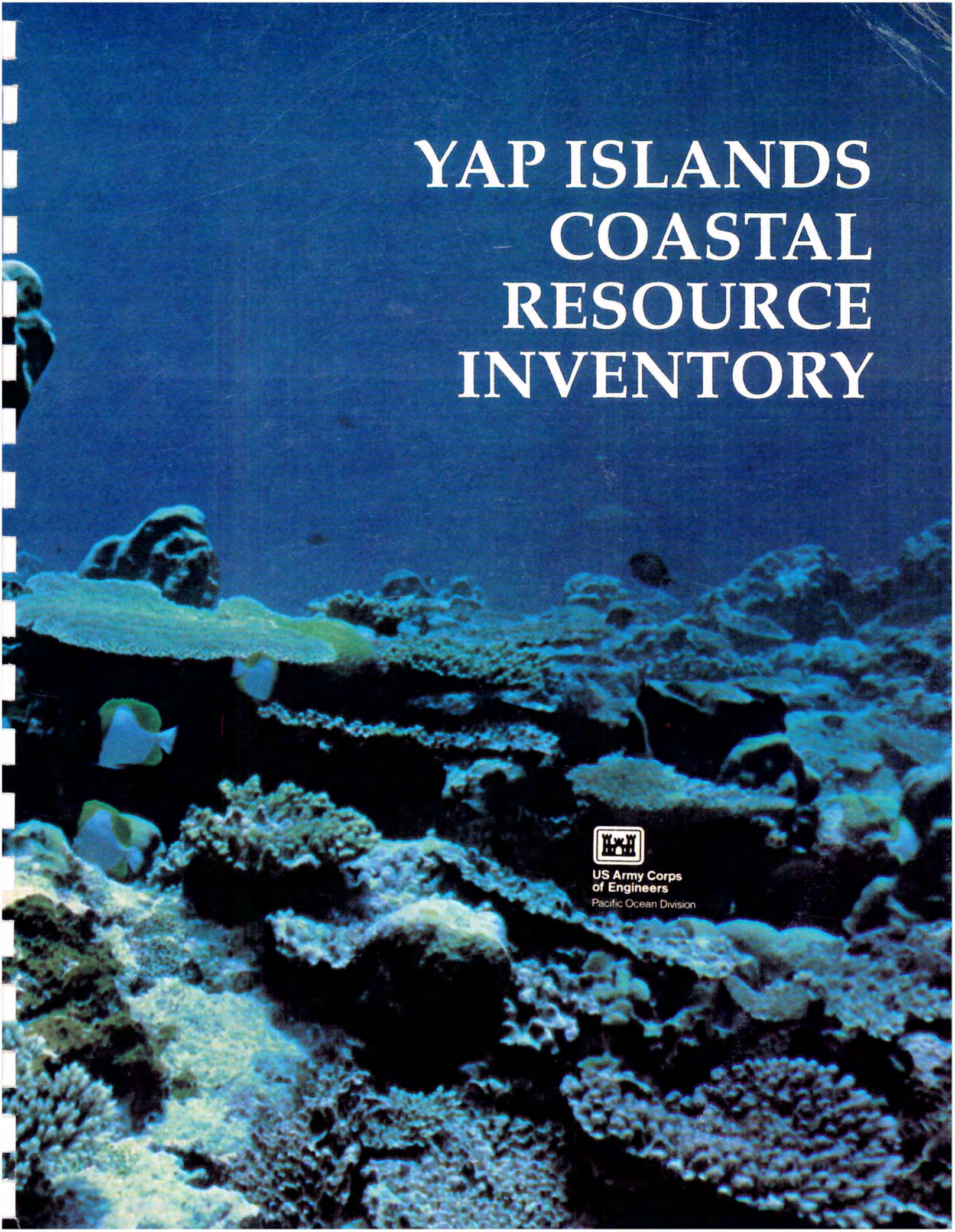
# YAP ISLANDS COASTAL RESOURCE INVENTORY



US Army Corps
of Engineers
Pacific Ocean Division

# YAP PROPER
# COASTAL RESOURCE INVENTORY

**PREPARED FOR:**

U.S. ARMY CORPS OF ENGINEERS

PACIFIC OCEAN DIVISION

FT. SHAFTER, HAWAII

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# ACKNOWLEDGEMENTS

The enthusiasm exhibited and knowledge shared by everyone participating in the Yap Coastal Resource Inventory project is priceless, and truly represents island and aloha spirit at its best. We could not have completed our work so thoroughly without the support we received. And thus, we would like to thank the following people for their contributions, both small and great.

Special thanks go to John Mangefel, the former Yap State Governor for requesting the YCRI and to Governor Tun, who has continued Yap's support through the final data analysis and publication. The Yap Department of Resources and Development, under the guidance of Sam Falanruw, and the Yap MRMD office, lead by Dr. K. Roger Uwate expedited our field work through their outstanding logistical support, including reliable boats and transportation to our reef stations. MRMD staff involved in field support included Mr. Jerry Fagolimul and Ms. Charmaine Price and Mr. Burl Sheldon, both Peace Corps Volunteers. Our boat operators, Daniel Dananged, Leo Siyou, Fal'al'ay and Faimau, made sure that we arrived safely at our stations despite the tides and raging rain storms. Despite long, sometimes rambling and taxing question to interpret, Paul Paatmag translated each question during interview sessions with a skill and exactness that would amaze many professionals. Both he and John Iou, now the chief of MRMD, provided tremendous and rich insight into Yapese life and fishing practices. Furthermore, Iou worked with us on providing adequate Yapese translations for English coral reef phrases. Throughout this project, the MRMD office also shared many reference materials on Yap with us and their able secretary, Mercy Issac.

Many other people from Yap also assisted us and include the following. Staff members of the Yap Fishing Authority provided information on their activities, with particular emphasis on commercial fisheries. Helpful individuals from YFA included Mr. Crister Freiberg, Manager, Mr. Chuck Sayon, Mr. Jim Moore, and Mr. Kurt Jacobson. From the Historic Preservation Office, Andrew Kugfus provided information on Yap's historic sites while Robert Finiginam of Environmental Health provided information on environemtnal regulations and problems. Constantine Yinug of the Planning Department provided information on the Yap Planning Department and CIP program. Mr Mike Gaan, Tourism Director, also provided information on Yap's tourism development program. Margie Falanruw provided invaluable expertise on the natural history, culture, and traditional fisheries of Yap. The Attorney General's office, particularly Manmaw and Mr. Brian Tamanaha, answered many questions and agreed to take Ms. Orcutt night diving. Mr Bill Acker of WAAB Transportation also provided insight into their marine activities.

Fishermen from throughout Yap Proper graciously agreed to be interviewed about their fishing activities. A special *mahalo* (thank you) is needed to Louis Sopluw, Waayan and Libyan of Rumung; Yilon, Kaded, and Jesus Betmag of Ruul; Falagurang, G. Rabee, Marimed, and Minginfal of Dalipeebinaew; Gililung, Falamar, Funugmar, Beengin, and Paatmag of Fanif and Weeloey; Funugchel, Yuwun, Taley, Liyey, Fas, Keufal, Tanag, Waayan, Falag, and Falan of Gilmaan; Moofal, Tamngig, Tamagchoy, Ruwechugrad, Falmeyog, and Gilmoon of Tamil; Anow, Magar, Sawayog, Nruw, Faimau, Forong, Datmag, Yinrow, Gubung, Ruot, Gasag, Fanathin, Kanang, and Alex of Kanifaay; Louis Pitmag and Manefel fron Gagil; and Kenrick, Yow, Tamag of Maap.

The field survey was successfully completed with the assistance of many Micronesian marine resource experts, many of whom have worked in Yap previously. We are greatful for the contributions from Mr. Barry Smith, Dr. Roy Tsuda, Dr. Steve Nelson, and Dr. Valerie Paul of the University of Guam (UOG) Marine Laboratory as well as the assistance of Mr. Mike Molina, a Fisheries Consultant for FSM, Mr. Mike Gawel, Chief Administrator of the FSM Marine Resources Division and Dr. James E. Maragos, Chief of the U.S Army Corps of Engineers Environmental Section. Although not a part of the survey program, Dr. Rosalind Hunter-Anderson of the UOG Water Resources Research Center, also contributed her knowledge on Yap's fish traps. Mr. John Engbring of the U.S. Fish & Wildlife Service, provided information on the marine birds of Yap.

In Honolulu, all the species lists were typed and edited by Mrs. Talita Bowen. The entire manuscript was critically reviewed by Dr. Maragos and Mr. Gawel. The algae narrative sections and species list were reviewed by Dr. Roy Tsuda at UOG. The coral species lists were reviewed by Dr. Maragos, while the fish species lists were reviewed by Mr. Molina, Mr. Gawel, Dr. Terry Donaldson of the Saipan Fish & Wildlife Service, and by Mr. Robert Meyers of the Guam Fish & Wildlife Sevice. The other invertebrates species lists were compiled and reviewed by Mr. Smith. The The Yap reef profiles and fish names were reviewed by Iou and Paatmag in Yap. Computer expertise was provided by Mr. Daniel Bauer of Sea Grant and Dr. Richard Titgen of the Hawaii Institute of Marine Biology. Dr. Bruce Miller and Dr. Jan Auyong of Sea Grant provided moral support throughout this process.

During this project, Dr. Sherwood Maynard, Director of the UH Marine Option Program, agreed to let Anne Orcutt take time off to participate in this project. This allowed her to pursue her educational goal of obtaining a Master's degree in Marine Resource Managment by completing her thesis research in Yap.

These acknowledgements can not begin to repay the many kindnesses received from these people and others in Micronesia and Hawaii who helped make this work possible.

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ACE = Army Corps of Engineers

DMA = Defense Mapping Agency

FSM = Federated States of Micronesia

MARC = Micronesian Area Research Center

MRMD = Marine Resources and Marine Development Office of Yap State

SGES = Sea Grant Extension Service at the University of Hawaii

TTPI = Trust Territory of the Pacific Islands

UH = University of Hawaii

UOG = University of Guam

USGS = United States Geological Survey

YCRI = Yap Coastal Resource Inventory

YINS = Yap Institute of Natural Science

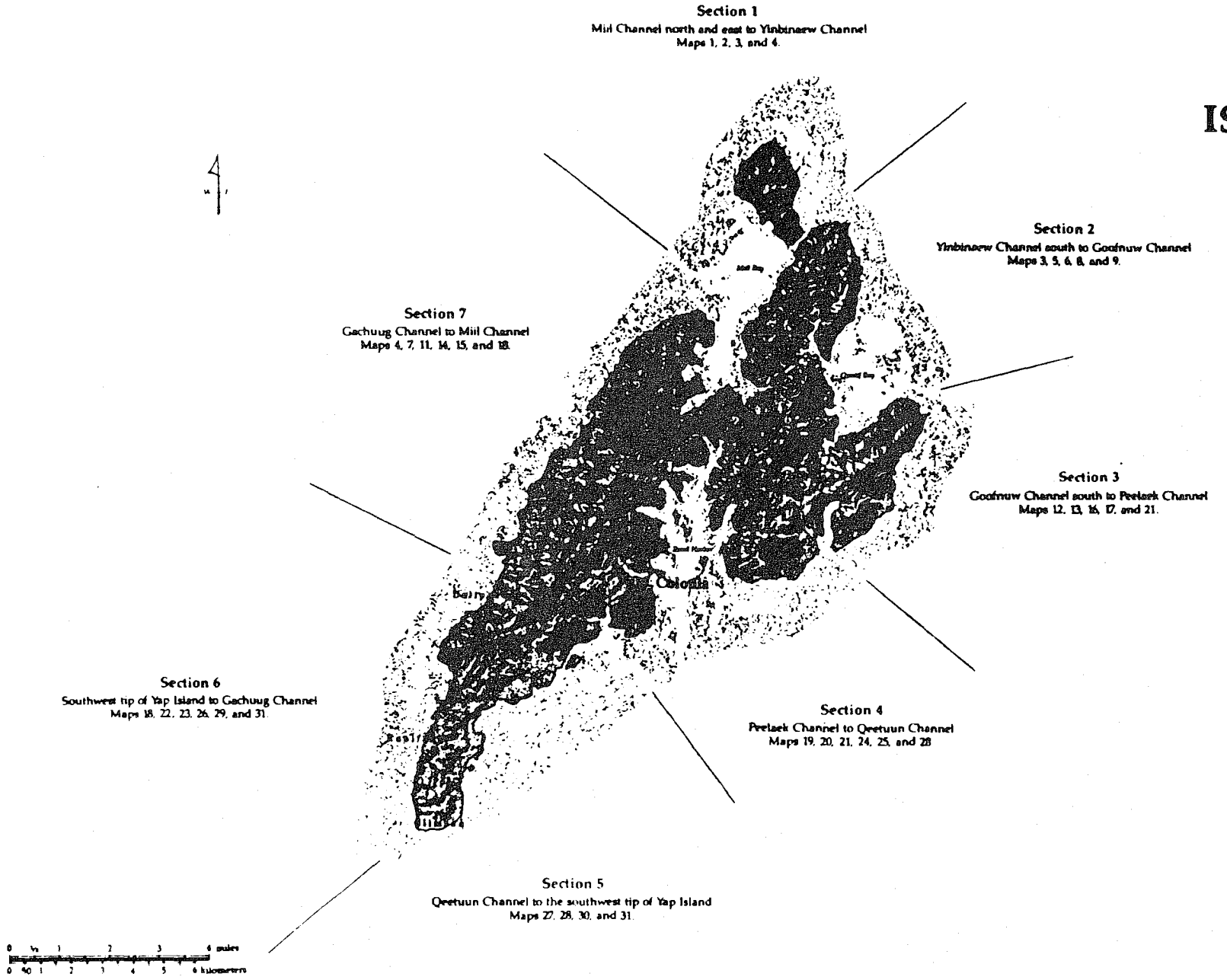
YFA = Yap Fishing Authority

## INTRODUCTION

In 1986, the Governor of the State of Yap requested the Army Corps of Engineers to prepare a coastal resources atlas and inventory of the Yap Island's Proper. At the request and support of the U.S. Army Corps of Engineers, Pacific Ocean Division, the Yap Coastal Resource Inventory (YCRI) was prepared by the University of Hawaii Sea Grant Extension Service under authority of Planning Assistance to States (Section 22 of the Water Resources Development Act) with matching support provided by the Sea Grant Extension Service (SGES). This report is the companion volume to the Yap Coastal Resource Atlas [100]. The Yap inventory is the first of several coastal resources inventories in Micronesia to be prepared by the SGES as a result of a grant from the Corps of Engineers. The SGES also provided assistance previously to the inventory program for Pohnpei State.

The Corps Coastal Resource Inventory Program has been under the direction of Dr. James E. Maragos since its initiation in 1978. Portions of the narrative report were written by Anne M. Orcutt, University of Hawaii (UH) Sea Grant Extension Service and graduate student of the UH Geography Department (corals, physiography, fishes, water quality, other invertebrates, algae, and other parts), Barry D. Smith of the University of Guam (UOG) Sea Grant Program (invertebrates), Peter J. Rappa of the UH Sea Grant Extension Service (resource uses) and Ross Cordy of the State of Hawaii Historic Preservation Office (archaeological and historical resources). Preparation of the report was coordinated by Anne Orcutt with Dr. Maragos supervising the final editing and publication. This report only describes the coastal resources of Yap Proper (*Waqab*) and does not include the outer islands of Yap State (Figure 1).

FIGURE 1. A MAP OF THE YAP PROPER ISLANDS SHOWING THE YAP PROPER COASTAL RESOURCES ATLAS MAP SECTIONS.




Index to Narrative Sections

## Purpose

On Yap and throughout the Pacific islands, small land areas and limited resource bases have traditionally promoted island management and conservation systems. Elaborate tenure systems were developed linking land and marine resources to individuals or clans. These systems, however, have been seriously disrupted by the introduction of refrigeration and by modern fishing techniques such as gill nets, dive masks, underwater flash lights, and small powered boats. Additionally, economic pressures and fast-paced urbanization have disrupted the traditional role and teaching of fishermen and marine resource conservation systems. As a consequence, the traditional island and reef conservation systems have become fragile and resources are vulnerable to overexploitation. For any future resource management program to succeed, it must be socially acceptable and recognize traditional marine tenure systems in the islands.

Coastal resource management is a holistic form of planning and decision-making that aims to maximize sustainable multiple uses of coastal resources [81]. The concept of a coastal zone, spawned from the U.S. Coastal Zone Management Act of 1972, has tended to restrict a coastal area to a pre-defined zone bordering a continental coastline. For islands, this concept is inappropriate because of their small land areas relative to their adjacent marine regions. In Yap, as in other Pacific Islands, there is virtually no land area that can be termed noncoastal. Hence, coastal management is, in effect, island resource management which includes the interaction between both land and marine resources.

The purpose of the Yap Coastal Resource Inventory (YCRI) is to describe the natural resources of ecological, recreational, subsistence, cultural, and commercial importance. This information is useful to Yap's coastal resource users and government officials who have cooperative responsibilities and interests in island resource management, fisheries management (including subsistence, artisanal, and commercial perspectives), land use planning and resort development, wildlife conservation, water quality management, historic preservation, recreation and tourism development and other forms of coastal resources development. This narrative report is designed to be used in conjunction with the atlas. Together, the report and atlas describe and analyze supporting baseline data which can be utilized to identify, use or conserve resources. This information will facilitate the development of a coastal resources management (CRM) plan by Yap State. The CRM plan could be a positive action plan which provides for wise management,

education and use of Yap's coastal resources while avoiding or mitigating adverse impacts on these precious resources.

**Report Organization**

The YCRI report consists of a summary section for all of Yap Proper, followed by seven geographic sections which correspond to the seven map sections of the atlas (Figure 1). Within each geographic section are the following subsections: GENERAL DESCRIPTION, PHYSIOGRAPHY, FLORA, CORALS, OTHER INVERTEBRATES, FISHES, OTHER VERTEBRATES, ARCHAEOLOGICAL AND HISTORICAL SITES, FISH TRAPS, RESOURCE USE, and WATER QUALITY. The same information is used in the SUMMARY section, but the information is for the whole Yap island complex. The following descriptions are brief explanations of the contents of the subsections.

**GENERAL DESCRIPTION**

This subsection gives a general introduction to the area including its geographic location, population, and geopolitical composition as a single or multiple municipality section. Notable natural and manmade features are also included as well as relevant cultural and economic information.

**PHYSIOGRAPHY**

Descriptions of the physical features of the terrestrial, coastal, and marine areas of each section, from the mountains and plateau's to the slope of the ocean reef, are described. The main emphasis of this section is on the marine environment.

**FLORA**

Under this heading, information is presented on marine plants observed during the field survey. Only the larger more conspicuous algae are noted; small or cryptic forms are not. Appendix A lists the flora species reported at the YCRI stations. The general distribution of sea grass beds and mangrove forests are described, while terrestrial vegetation is not included.

**CORALS**

Information on corals seen during the YCRI field survey is presented under

this heading. Included here are the stony corals including reef corals (Order Scleractinia), blue corals (Order Coenothecalia), some members of the class Hydrozoa such as fire corals (Milleporina, Stylasterina, etc) and soft corals (Order Alcyonacea and Order Zoantharia). Other members of the phylum Cnidaria, such as sea anemones, are included under OTHER INVERTEBRATES. Emphasis is on describing large and common corals which contribute the most to overall coral cover and a list of other corals encountered within a 20-30 minute period at each field site. Appendix B lists the coral species reported at the individual YCRI stations.

### OTHER INVERTEBRATES

Information is presented on invertebrates, other than corals, which were found at YCRI stations during the field survey. Some observations reported by local fishermen during interviews are also included. The conspicuous macroinvertebrates, particularly the crustaceans, echinoderms, and mollusks are usually noted; small or cryptic invertebrates usually are not. A comprehensive list of the other invertebrates seen at the YCRI stations is compiled as Appendix C.

### FISHES

Fish species observed at YCRI surveys during the field survey are included in this section. Some observations reported by local fishermen during interviews are also included. Emphasis is on important Yapese food fish and commercially valuable species. A comprehensive list of the fish species observed by station is compiled in Appendix D.

### OTHER MARINE VERTEBRATES

Under this section, information on sea turtles, birds, and marine mammals is presented. Observations reported by local fishermen during interviews are also included.

### ARCHAEOLOGICAL AND HISTORICAL RESOURCES

A brief synopsis of known coastal archaeological and historical resources found in each section is presented in this section.

### RESOURCE USES

Information is presented on the current utilization of known resources

according to data gathered during interviews with local resource users. Topics covered, as appropriate, include nearshore fisheries, sand dredging and mining, harbor facilities, mangrove harvesting, existing and potential recreational opportunities, resort development, landfilling and dredging, and land use. Where applicable, relevant documents are cited for supplemental information. Appendices E and F represents a list of the resource user interview sessions including the master resource list used during the interview sessions and the participants at each interview session.

## WATER QUALITY

Information regarding the quality of marine waters is presented under this heading. The classification of marine waters in each section are given according to the FSM Marine and Fresh Water Quality Standard Regulations (Appendix G), which were originally promulgated under the TTPI and subsequently adopted by the FSM upon independence (FSM Code of Law, Title 25, Sec. 708). Significant natural or manmade discharges affecting water quality including both point and non-point sources are identified, and general observations of water quality and oceanographic conditions made during the YCRI field survey are noted.

## METHODOLOGY

Data for this report and the Yap Atlas were obtained primarily from field surveys and interviews with local marine resources users and other residents and officials of Yap. Additionally, data from previous scientific investigations were also reviewed for supplemental information. Unlike other recent coastal inventories, sufficient aerial photographic coverage was not available for use in the field work. Expertise during the field survey portion was acquired by participation from members of the University of Guam (UOG) Marine Laboratory, FSM Marine Resources Division, Yap Marine Resources Management Division (MRMD), Yap Institute of Natural Science (YINS), University of Hawaii Sea Grant College Program (SGES), and Environmental Resources Section of the Army Corps of Engineers (ACE). Because of the collaborative nature of the program, data collection proceeded in several phases to accommodate scheduling of personnel and boat support.

In September 1986, funding for the program was secured and a preliminary scoping trip to Yap was made by Dr. James Maragos, director of the Pacific

inventory program. Informational and logistical meetings were held with the Yap State Governor's Office and Mr. Sam Falanruw, Director of the Yap State Department of Resources and Development. At that time, the Yap Marine Resources and Management Division (MRMD) was identified as the principal liaison agency to assist with logistics, data collection, information dissemination, and administrative support of the YCRI program. Arrangements were made for the second phase which included one week of interviewing Yap's coastal resource users, primarily fishermen, and designation of coral reef field survey sites. The majority of field work and interviews were accomplished during a one month expedition in April 1987.

### Interviews

The availability of accurate information on resource uses, functions, values, and future demands upon them is scarce in most FSM States. Hence, group and individual interview sessions with experienced resource users can quickly gather information on the traditional, subsistence, and artisanal uses of Yap's reef resources. Johannes [63] has used interview methods to determine ethno-marine biological information on tropical coastal fisheries in the Pacific and has described their uses for resource management [63,64]. Abbreviated methods have been successfully incorporated into coastal resource management inventories completed in Hawaii, American Samoa, Truk, Pohnpei, Kosrae, and now Yap [2,3,4,5,6,7,13,47,77,78,79,80,89,90,100,131 ], and are in progress for Kwajalein, Arno, and Majuro Atolls.

Interviews on Yap were conducted for one week in October, 1986, and one week in October, 1987 with knowledgeable marine resource users and other key Yap State government agency officials having coastal oriented programs or expertise. MRMD arranged for a series of meetings with knowledgeable marine resource users in each of Yap's ten municipalities, to gather detailed information on the use of reef resources. Interviews were conducted by Peter Rappa, SGES and Paul Paatmug, Fisheries Officer of MRMD, who served as an interpreter and fishing specialist during the sessions. A list of marine resources typically harvested in Yap was compiled by Paatmug and Dr. James Maragos, and used as a working template for discussions (Appendix E).

At each interview session, participants were presented with explanations, both in Yapese and English, on the purpose of the inventory project and meeting.

Additionally, they were shown a copy of the Pohnpei Resource Atlas [79] as an example of how their contributions would be used. Using the list compiled by Paatmag and Maragos, the fishermen were asked to indicate on maps the areas where various types of resources are harvested in their region. To supplement this information, participants were also asked to describe resource problems, and whether the abundance of each resource category was increasing, declining or staying the same. Additionally, they were asked to describe the type(s) of gear used in harvesting fishing resources.

All participants who signed attendance sheets are listed in (Appendix F). Other agencies involved in the interview sessions (October, 1987) besides MRMD include: the Yap State Department of Resources and Development, Historic Preservation Office, Tourism Office, Department of Public Utilities and Contracts, Environmental Protection Authority, Department of Planning and Budget, Yap Fishing Authority, and WAAB Transportation.

**Field Survey**

As mentioned previously, the field data collection phase was conducted during several periods over seven months (October 1986 to April 1987). Most of the YCRI field survey sites were sampled by all investigators, with several exceptions. Because the UOG algae Team was previously committed to another MRMD project, A survey of economically important alga in Yap, they agreed to survey only YCRI stations if time permitted. As a result, the algae team was able to only complete 24 YCRI inshore stations. Only cursory observations of macroalgae species were made on the ocean YCRI stations. Several other station locations were moved because of dangerous currents or marine life conditions (YCRI Station 6, 11, 13). On these occasions, the site was moved nearby and within the same ecotype.

**Site Selection**

Designation of the YCRI field survey sites occurred during a one week period in October 1986. Site selection was based upon the premise of sampling as many different kinds of ecotypes on both the windward (east) and leeward (west) sides of Yap. A tow board survey technique was utilized to quickly characterize Yap's ocean coral reefs into different ecotypes. During these surveys, a snorkeler was pulled on a tow board about 50 feet (15 meters) behind the MRMD boat and

recorded substrate composition, interesting and unique geomorphology, and unusual marine life communities. Along the inshore reef flat, spot snorkel and boat surveys were conducted around the entire island, tides permitting. Results of this week long site selection period included designation of 52 stations around the Yap island complex, including 18 offshore and 34 reef flat and lagoon stations. The major marine ecotypes sampled by the marine survey team were mangrove, sea grass, coral reef, embayment, beach, lagoon hole, reef pass, and ocean areas. Personnel involved in YCRI site selection included Anne Orcutt, SGES, and Charmaigne Price and Burl Sheldon, both Peace Corps Volunteers stationed at the Yap MRMD Office.

The field survey was qualitative in nature. The amount of time spent at each station was determined by the relative complexity of the reef environment, weather and sea conditions and safety considerations. Each team member, using clip boards, waterproof paper, and species checklists, recorded data on assigned specific organism groups and/or sketched reef features. Information on the relative abundance of algae, corals, other invertebrates, fishes, and reef features was also recorded (Appendix H). In general, only larger, more conspicuous species were recorded while other small, cryptic, or nocturnal species were only incidentally, observed. Photographs and specimens were also collected for the purposes of species confirmation, identification, and obtaining more information. All surveys were performed with snorkeling or scuba gear to a maximum depth of 60 feet (18 meters).

A reference collection of coral species observed in Yap was assembled and labeled by Dr. James Maragos and has been deposited with the Yap MRMD office [25,97,117,118,119,120,121,122]. Fish specimens, including new records for Yap, were also collected by Mr. Mike Gawel and deposited with MRMD. Additionally, a fair number of macroinvertebrates other than corals, primarily mollusks and echinoderms of questionable identification, were collected and identified by Mr. Barry Smith and deposited in the UOG Marine Laboratory reference collection [12,24,25,27,41,44,70,71,82,86,98,108,]. Team members and their areas of concentration were: Mike Gawel, fishes, corals and invertebrates; Anne M. Orcutt, fishes and reef physiography; Mike Molina, fishes; Barry Smith, invertebrates; Dr. James Maragos, corals and reef physiography; Dr. Roy Tsuda, algae; Dr. Valerie Paul, algae; and Dr. Steve Nelson, algae.

**Literature Review**

Information collected by previous investigators with a marine or coastal emphasis were also reviewed to supplement the field survey data. Literature searches were conducted at the Corps Environmental Resources Section office, UOG Micronesian Area Research Center (MARC), Pacific Collection of the UH Hamilton Library, and at the YINS. Notable contributions were from reports prepared by the University of Guam Marine Laboratory, particularly a comprehensive marine survey conducted in 1978 [109]. A coastal bibliographic review of Yap District was recently compiled by Eldredge, [109] and the YCRI does not attempt to duplicate this effort. Sources sited in this report are referenced throughout the text by numbers appearing in brackets [ ] and are listed in the reference section at the end of this report. Yapese spellings are taken from the Yapese-English Dictionary [61] and the Yap Islands (*Waqab*) U.S.G.S. topographic map (scale = 1:25,000). If the Yapese fish name was not given in the Yap-English Dictionary, the Yapese term was taken from the list generated by Jacobson [60] of the Yap Fishing Authority. Important terms are defined in the glossary.

Each section will describe the marine floral and faunal components according to the following reef zonation pattern which typifies Yap's reef system (Figures 2 & 3). The transect or reef profile commences on land and moves seaward to the ocean reef terrace. Interesting geomorphological reef anomalies occur throughout the Yap coral reef system, and these are highlighted in the appropriate Section(s).

FIGURE 2. SCHEMATIC PROFILE OF YAP PROPER'S REEF STRUCTURE

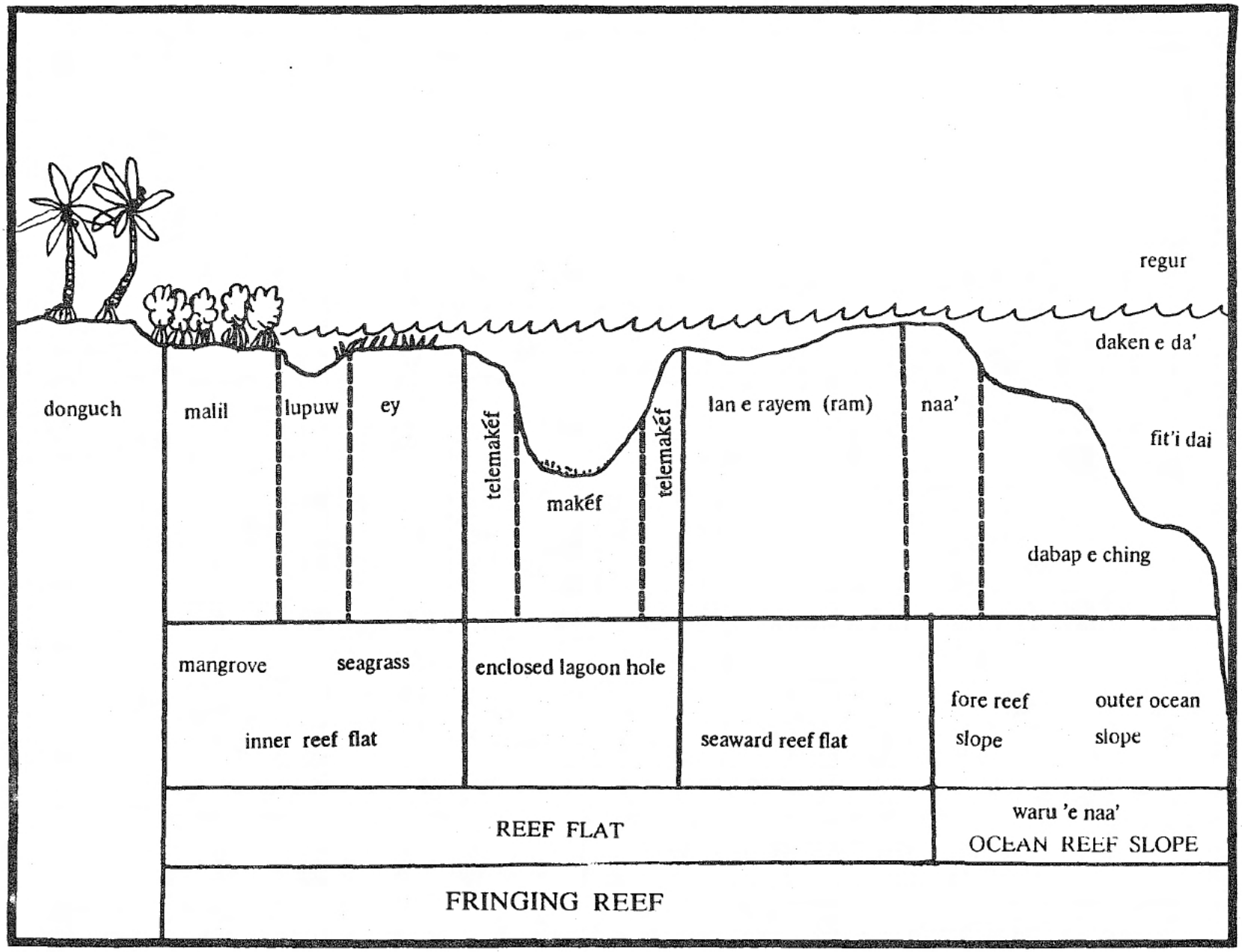
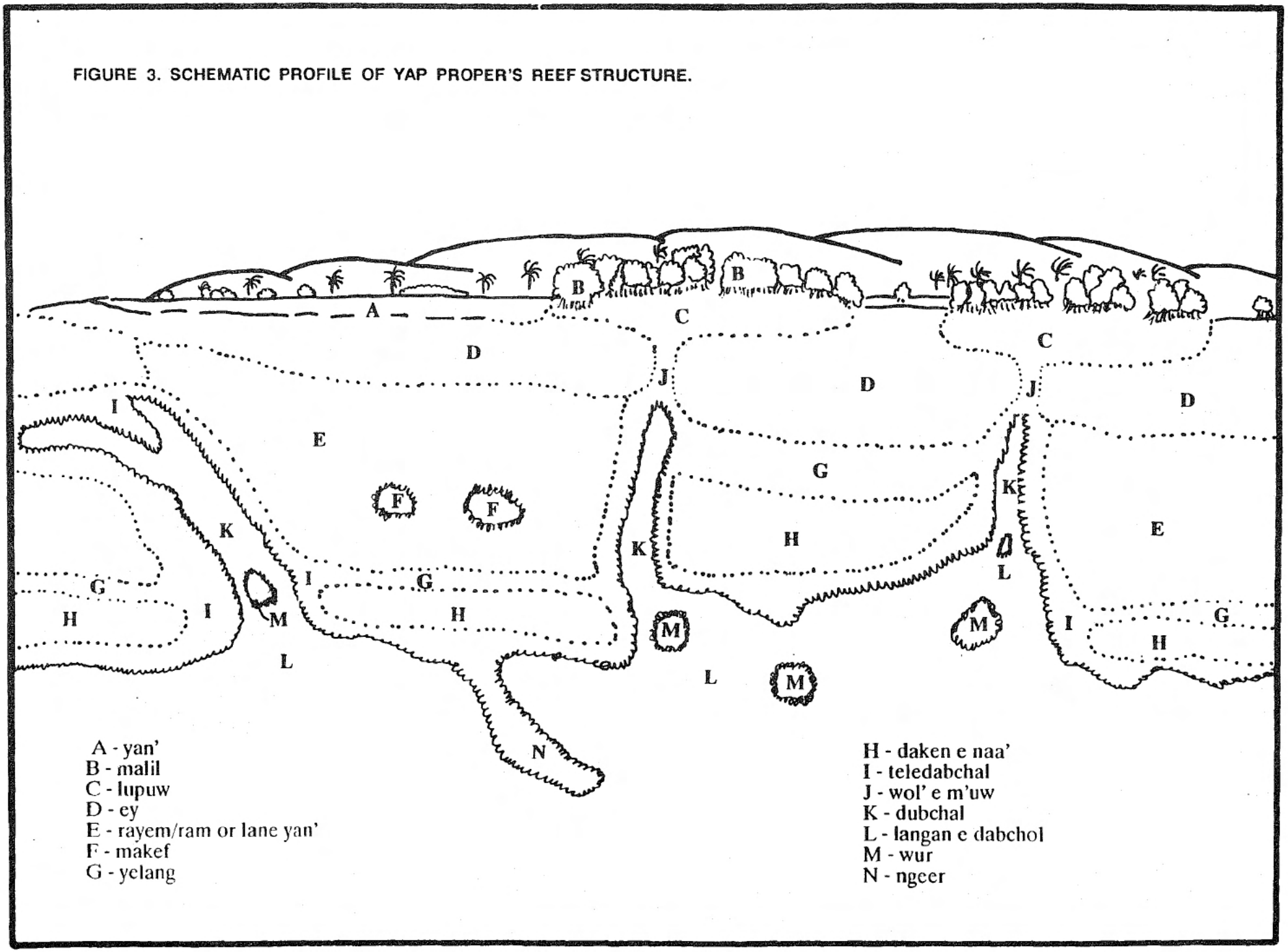


FIGURE 3. SCHEMATIC PROFILE OF YAP PROPER'S REEF STRUCTURE.



## SUMMARY

### GENERAL DESCRIPTION

Yap Proper is a complex of four high islands linked together in the Caroline Islands, situated about nine degrees or 950 kilometers north of the equator. Yap lies on the Guam-Saipan-Palau-Philippine axis and just inside the pathway of tropical disturbances and typhoons [23]. The climate is invariably warm and humid with temperatures ranging between 75 - 85 degrees Fahrenheit. Rain occurs throughout the year in Yap, although there are pronounced dry and wet seasons. There is a definite increase in precipitation between May and October, with drought-like conditions sometimes occurring between April and June.

About three-quarters of the present population in Yap State resides on Yap Proper. In 1980, Yap Proper's population numbered 8,734 of which 1,474 lived in and around the main urban center of Colonia [116]. The remainder of the population lives elsewhere around the island in Yap's ten municipalities, which are comprised of numerous villages. Typically, these villages are located along the coastline. Subsistence crop farming is the main agricultural enterprise in Yap; the major crops include cassava, taro, sweet potatoes, yams, bananas, and coconuts. Copra is produced intermittently, and marketed as an export crop. Pigs and chickens are common livestock. Food resources are actively obtained from the mangrove forests and offshore coral reefs. The local economy is also supported by fishing, handicrafts, tourism, and government jobs.

## SUMMARY

### PHYSIOGRAPHY

The Yap Islands Proper consists of a complex of four major islands and ten small islands compactly arranged in an elongated triangular group. The group is entirely surrounded by an extensive fringing reef system. At the northern and southern outer limits of the reef, the complex is 31 kilometers (19 miles) long while the eastern and western reef boundaries have a width of 12 kilometers (7.5 miles). The total land area of Yap Proper is 95 sq. km (36.8 sq. miles)[65].

Yap has one the longest coastlines in FSM because of its complex and highly irregular shape. This includes several large embayments, multiple peninsular extensions of varying sizes and configurations, and many individual, offshore islands. The complex is the largest high island in Yap State and the third largest in the FSM.

#### Islands (Donguch)

Although their configuration varies, the four major islands of Yap, Tamil-Gagil, Maap, and Rumung generally rise steeply at the shoreline as cliffs or scarps 6-10 meters (20-30 feet) high, from either a narrow coastal plain, beach or shoreline, to a series of ridges and valleys. The highest peak, Taabiywol, located on the island of Yap, rises to an elevation of 174 meters (522 feet). Unlike the other islands, Yap Island has a central plateau which gradually merges with a coastal plain at the southernmost end of the island in the Municipality of Gilmaan.

#### Coastal Zone

An extensive fringing reef system encircles the Yap Proper complex which can be further divided into windward (eastern) and leeward (western) categories. The widest reef extensions occur at the southern and northern ends of this complex, representing 3.5 kilometers (2.1 miles) and 2.5 kilometers (1.5 miles) respectively, while the narrowest strips are no less than 200 meters (1000 feet) wide on the western reef. The outer reef flat margins are bisected by eight deep channels of varying lengths. Three of these channels, Miil, Qatliirow, and Goofnuw lead into deep, well developed embayments which connect the lagoons with oceanic waters outside the reef margin.

Seaward of the Yap shoreline, the major physiographic zones encountered include the fringing reef and ocean terrace, each having several components. The

nearshore region is fringed by mangrove forests, comprising 1,171 hectares (2,894 acres) and 12 percent coverage of the total land area. These forests typically punctuate the coastline and are especially well developed at the mouths of drainage systems and on mud flats (Section 2, 3, 4, and 7) [36]. A combination of coral rubble and calcareous sand are the predominant substrate material on the inshore reef flat, with terrigenous materials becoming increasingly abundant closest to the mangrove stands and the shoreline. Just seaward of the shoreline and mangroves, a band of seagrass of varying densities circumscribes the entire Yap Island complex. Further, seaward, the fringing reef flat, which has an average depth of 2-3 meters (6-10 feet) at high tide, is composed of a solid reef rock and calcareous sand tract with very high coral coverage in isolated enclosed lagoon holes and coral thickets. The reef flat margin consists of a consolidated limestone wave swept platform and low microatolls.

**Enclosed Lagoon Holes (Makef)**

An interesting and unique feature of the Yap Island complex fringing reef system are enclosed lagoon holes located on both the windward and leeward reefs. Haphazardly dispersed throughout the fringing reef flat, these features vary in depth, size, and configuration. Generally, their size varies from 10 meters to 1.5 kilometers in diameter (30 feet to 0.9 miles) with depth ranges between 3-22 meters (10-72 feet). Additionally, these reef shapes are highly irregular, ranging from elliptical, to sinuous, or rectangular, with a tendency to be elongate rather than wide and oriented parallel to shore. These enclosed holes probably represent the remnants of a lagoon and barrier reef system which has been filled in by sediments and closed by active reef growth.

Coral features within each hole are also variable. In some regions (Section 6), a network of these enclosed lagoon holes are interconnected by dense coral thickets. In other areas, particularly isolated holes, the margins are completely rimmed with coral. Larger holes, such as Laeneachoqol in Gagil-Tamil (Section 2), commonly have several large patch reefs within them. Others have pinnacles and staghorn coral thickets. Holes located on the windward fringing reef, display a trend whereby the seaward margins are comprised of a talus slope of coarse to fine sand transported into the holes by waves and currents from the outer reef areas. Conversely, a band of high coral coverage usually dominate the leeward enclosed lagoon holes. With the exception of the aforementioned areas, the top 1-10 meters

(3-33 feet) of the lagoon hole slope supports moderate coral growth and diversity. All lagoon holes have calcareous sand and rubble bottoms.

**Embayments and Channels (Dubchol / Langan e Dubchol)**

Coral coverage within an embayment varies depending upon location. The inshore reef and the most interior channel walls of an embayment are depauperate. Low species diversity and abundance can be directly linked to the environmental stresses caused by terrestrial sediment and fresh water runoff onto the reef flat. Near the embayment openings, coral coverage increases particularly in calmer, backwater bays. Fairly dense coral assemblages blanket the walls to depths of 10-25 meters (33-83 feet). Large sand and talus patches are also interspersed among the coral expanses. Patch reefs are also found within the boundary of Miil and Qaniif embayments. All embayments are flooded tidally with oceanic waters which penetrate the entrance corridor of narrow, steep-sided, and deep channels into the embayment. The channels that bisect the outer reef flat typically have narrow mouths with a 1000 meter (3330 foot) long neck that connects to the interior embayments.

**Ocean Slope**

The outer edge of the reef flats are dominated by a consolidated hard and flat reef pavement with low live coral coverage, but high crustose and turf algae coverage. The breaker zone of the reef occurs seaward at the top of the fore reef slope. The fore slope margin receives the most impact from incoming waves and overall coral coverage is lower and coralline algae coverage is higher. This solid reef rock pavement begins gradually to descend to deeper depths with small, closely cropped colonies of coral species tolerant to intense wave action. In isolated locations, particularly along the windward coast, this zone merges with a developed spur and groove system. But most frequently, the relatively robust wave zone converts into an ocean reef terrace system with luxurious and diverse coral growth to a depth of about 15 meters (50 feet). On Yap's windward side, this gradual terracing extends seaward to roughly 30 meters (100 feet) while on the leeward side, the terracing ends abruptly with a steeply dropping reef wall (a 80-90 degree slope) descending to a depth of 30-60 meters (100-200 feet). The deep channels through the reef flat margin are usually bounded by steep reef walls, mostly scoured, but with some coral coverage. A mixture of terrigenous sediments and calcareous sands comprise the channel floors.

## SUMMARY

### FLORA

Mangrove forests represent a fairly conspicuous component of the shoreline vegetation surrounding the Yap Proper islands. Vegetation dominating these forests are under tidal and estuarine influence with members of the mangrove family Rhizophoraceae dominating [103,104,36]. The forests cover about 1,171 hectares (2,894 acres) or about 30.2 percent of the total forested area of Yap [36]. The typical seaward mangrove species on Yap is Rhizophora mucronata, and occasionally its seedlings are found far out on the seagrass beds [104]. One species of Rhizophora is also reportedly colonizing the stone "arrow" fishtraps (*atch or qech*) on the seagrass beds. On Yap, the mangrove stands are most well developed along the nearshore mud flats and drainage basins, with the largest stands found along the southeastern side of Tamil-Gagil island and along the western side of Ruul near Yinuuf village.

Mangrove forests generally occur in sheltered areas protected from wave action exposure. Calm waters influence most mangrove forests which encourages the settlement of suspended silt and terrestrial soils amongst an intricate network of mangrove roots. Because of this, mangroves have sometimes been implicated in land formation. In effect, the mangrove serves as a natural filtering and buffering system between the island and the adjacent fringing reef system. They are also ecologically and economically important to most Pacific islanders including the Yapese, for construction material, craftwood, firewood, fishing and gathering grounds, and provide habitat for marine organisms such as fish, crabs (*qamaang, qurich, galip*), birds, and fruit bats (*maegl'aew*) [103,36].

The mangrove forests have been recently mapped as part of vegetation survey of Yap [36]. YCRI stations included only the seaward margins of the mangrove forest (generally) less than 3 meters in width and did not include information on mangrove species.

Yap's reef flat assemblages of algae reflect four distinct habitats: the mixed seagrass beds mentioned previously, a sandy area with scattered coral heads and seagrass, reef areas with lush live coral development, and a consolidated reef pavement zone near the outer reef flat margin [109]. Seaward on the ocean reef terrace, algae is an inconspicuous component of the coral reef structure.

Seagrass assemblages are not yet balanced and are in various stages of successional patterns throughout Micronesia [69]. In a discussion of the

distributional patterns of seagrasses in the Micronesian region, Tsuda et al. [109] reported a distinct trend of fewer species as one moves from west to east in the Caroline Islands. In the case of Yap, it has the second most diverse assemblage of seagrasses featuring seven species; Belau only exceeds it in diversity by two species (9 species total) [69]. During the YCRI, three of the seven seagrass species were observed; the low diversity being accounted for by both limited time and visitations to only eight seagrass stations throughout Yap.

The majority of Yap Proper's seagrass beds are distributed in a mixed species zone running parallel to shore which are generally separated from the mangrove stands by a narrow band of unvegetated sand or silt. These beds may extend out over large areas of the fringing reef flat and commonly blanket the interior portions of Miil and Tamil embayments. The most frequently encountered and widely distributed seagrasses in Yap are Thalassia hemprichii followed by Enhalus acoroides and Cymodocea rotundata [69].

Similar to the mangrove forests, the seagrasses also act as traps for terrigenous silts and sediments. Additionally, the seagrass beds serve as important habitats for some invertebrate animals such as sea cucumbers and clams as well as some species of fish, particularly siganids (*daruuy, garmiy*). Furthermore, a population of intermediate sized green sea turtles (Chelonia mydas or *weel*) utilize Yap's seagrass beds as a resting and foraging haven. Yap has several seagrass genera, Thalassia, Cymodocea, and Halophila, that are commonly consumed by green sea turtles worldwide [43].

During the YCRI, only 31 species of marine algae were found at the stations surveyed, representing 21 percent of the 143 species known to occur in Yap [109]. Two additional species of algae, Cladophora sp. and Neogoniolithon sp., were identified during the YCRI expanding the list of known algae species from Yap to 145 species. An examination of the species diversity by Hedlund and Tsuda [109] suggested that fish grazing is one of the principal factors limiting species diversity and coverage in the lagoon holes, in addition to siltation.

## SUMMARY

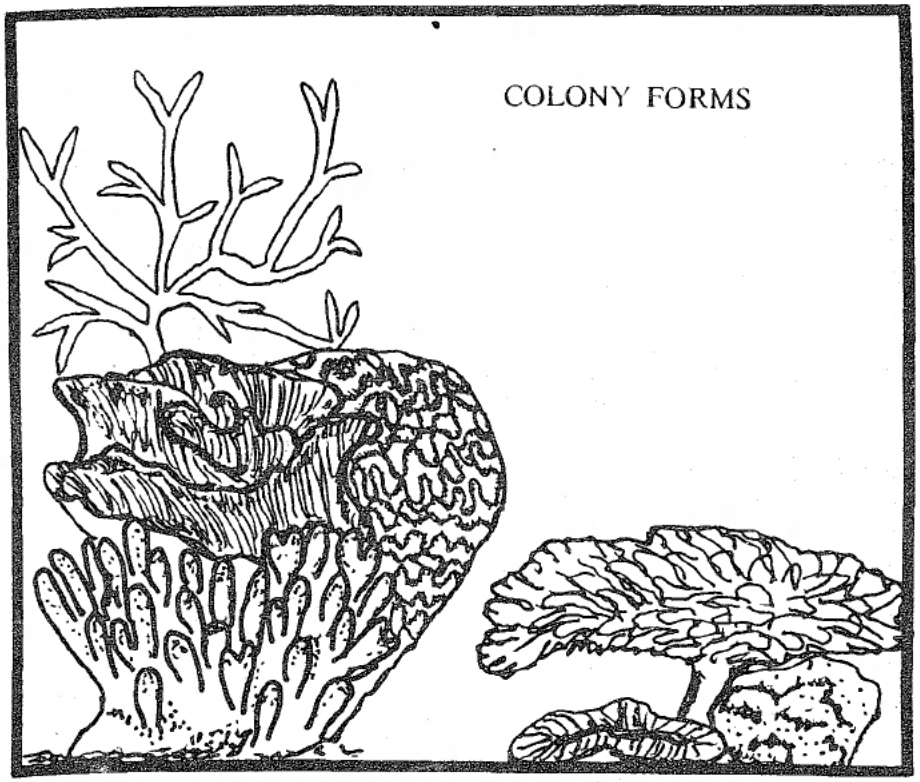
### CORALS

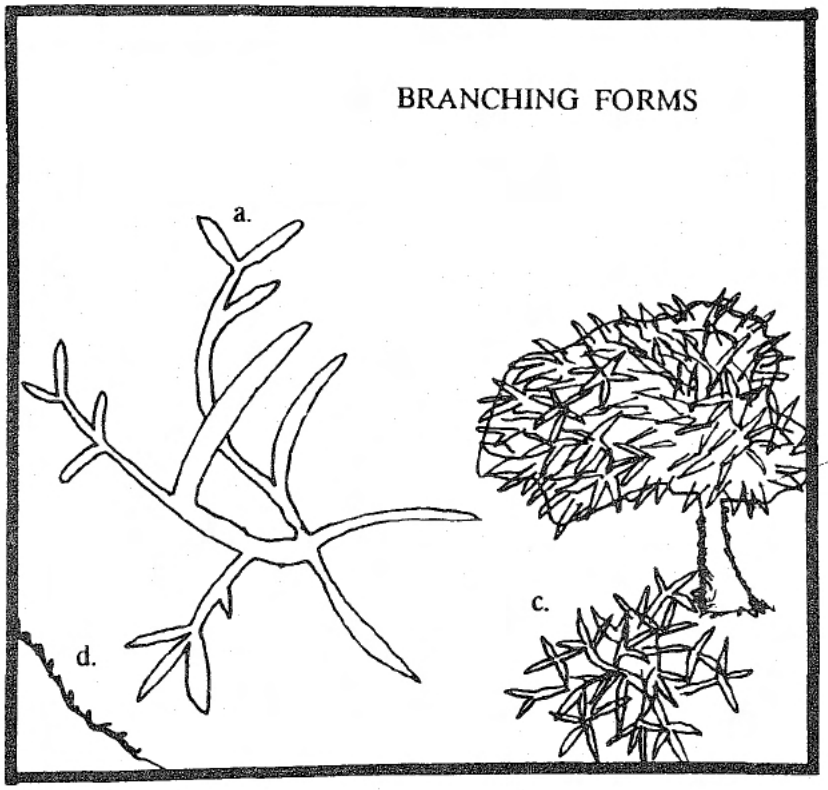
Information on hard corals seen during the YCRI field survey is presented under this heading. Emphasis is on describing large and common corals which contribute to the overall coral cover. As applicable, the growth forms (or morphology) of particular corals are given for a more accurate description of the coral reef environment. Thus far, twenty-one families of corals representing 63 genera and 207 species were observed in Yap during the YCRI survey. Appendix B is a cumulative species list of corals observed by station during the YCRI field work.

Both solitary and colonial reef corals are common in Yap. The solitary corals are often unattached as illustrated in Figure 4. The most conspicuous group of solitary and related colonial corals in Yap are the mushroom corals (Family: Fungiidae) that form unattached discoid shapes. Most of the reef corals, however, are attached colonies displaying a variety of different growth forms. Generally these forms are described by their shapes. The most commonly used terms for colonial forms are: columnar (forming columns), foliaceous (leaf-like plates), massive or head-like, braincorals (hemispherical colonies of the family Faviidae), ramose (branching), encrusting (low-profile adhering to a surface), vasiform (large ice-cream cone shaped tables on pedestals), and corymbose (small tables). Other types of branching include arborescent (staghorn) and cespitose (finely branching). Some coral species may exhibit more than one type of colony form and others are intermediate between one type and the next. A good example, and often confusing one, is Porites (S.) rus which may have two growth forms in one colony; the upper part consists of columns and the lower part of shelving plates.

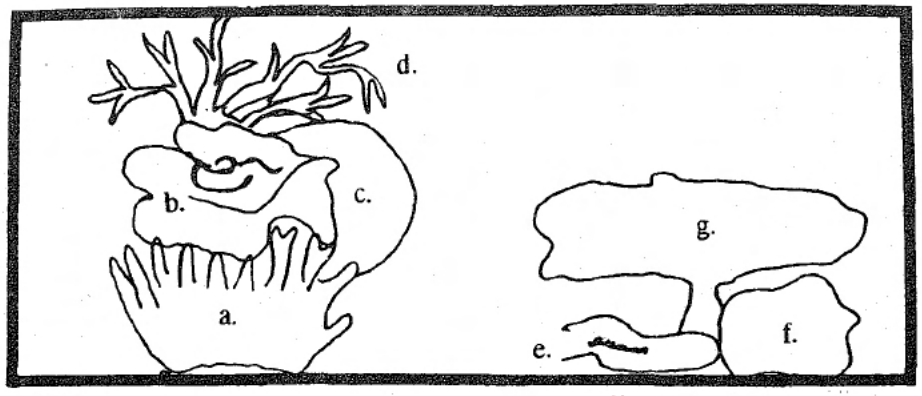
Specific coral growth forms are often associated with specific zones along a transect or profile of the reef ecosystem. Massive corals form flat-topped, pancake-shaped microatolls on the reef flat where exposure during low tides and sediment and fresh water runoff restricts upward growth. The coral Porites lutea is the most prominent species of the microatoll forming corals in Yap. Corals on the upper slope, continuously exposed to pounding ocean waves, are small, often encrusting, stunted, and solidly constructed. Deeper, where the wave action is less, coral colonies become larger and more delicately branched (staghorn, vasiform, foliaceous) and a much wider range of forms appear. These changes occur in response to changes in the environmental gradients, especially sunlight exposure, wave action, and turbidity. Frequently, individual species exist in more than one reef zone but express different growth forms.

FIGURE 4. COMMON CORAL GROWTH FORMS FOUND IN YAP PROPER.




a. arborescent or staghorn
b. vasiform, or table
c. cespitose or finely branching
d. encrusting




a. columnar
b. foliaceous, forming a whorl
c. brain coral
d. ramose or branching

e. solitary mushroom
f. massive
g. corymbose or table

OTHER INVERTEBRATES

Epibenthic macroinvertebrates comprise a diverse and conspicuous component of the nearshore marine fauna of Yap. The predominant phyla are sponges, cnidarians other than scleractinian corals, molluscs, echinoderms, and ascidians.

The marine environment of Yap provides habitat for an astonishing diversity of sponges. However, few species could be identified with any confidence in the field because of the perfunctory state of the taxonomy of the sponges of the region. Therefore, distinctive morphology and color were the bases of the assessment. Greater diversity and densities of sponges occur in the turbid waters of channels and embayments, although the phylum is represented in all of the habitats surveyed. No species with obvious potential for commercial development were noted.

Cnidarians other than scleractinian corals constitute perhaps the most conspicuous faunal element of the macrobenthic invertebrates. The demersal jelly fish Cassiopea medusa is found in seagrass meadows and channel floors, where it can be observed pulsating with its aboral surface resting on the fine sediments of the substrate.

Octocorals are the most diverse group of nonscleractinian corals. The stoloniferan Clarularia sp. is widespread at Yap, but attains its greatest abundance in enclosed lagoon holes and on the fore reef slope of the northern islands (Sections 1 & 2). Only scattered clusters can be observed in enclosed lagoon holes associated with the southern reef flat, but the species can be found more commonly on the fore reef slope in this area.

Alcyonacean soft corals are the predominant soft corals. Species of Sinularia, Lobophytum, Cladiella and Sarcophyton are widespread and common to abundant, except in the turbid waters of mangroves, channels, and embayments. These and other species are abundant on the slopes of enclosed lagoon holes, where soft corals attain their greatest species diversity.

Anemones are widely distributed in the reef system of Yap, but no species is abundant. Species with and without clownfish commensals occur in clear water on the reef flat and on the fore reef slope.

The wire coral Cirrhipathes sp. is common in the turbid waters of channels and embayments. These antipatharians often extend outward and upward from beneath the rocky outcrops. Although they occur in shallower water, wire corals

usually reach their greatest abundance at depths exceeding 6 m.

Two nonscleractinian cnidarians warrant mention for their potential harm to humans. The hell's fire anemone Actinodendron sp. occurs in relatively turbid waters in seagrass meadows and embayments. The large fan-like hydroid Aglaophenia cupressina occurs in high numbers among colonies of the coral Porites cylindrica in some enclosed lagoon holes. Both of these species are capable of inflicting serious and painful stings when contacted by divers.

Polychaete annelids are represented by two conspicuous species, although there undoubtedly are many infaunal species present. The Christmas-tree worm Spirobranchus giganteus is usually associated with massive colonies of scleractinian corals. The feather duster worm Sabellastarte sanctijosephi is more widespread and occurs on a substrate of both living and dead coral.

Molluscs comprise the most diverse phylum of macroinvertebrates. Gastropods are the richest element of the molluscan assemblage, with 38 conspicuous species observed. Of these, families such as the cowries and coneshells are valued in the trade of seashell collectors. The commercial topshell Trochus niloticus forms the basis of an important commercial fishery throughout Oceania. In Yap, topshells are harvested seasonally for export to button manufacturers in the Orient. Larger individuals of harvestable size (>76 mm) occur on the ocean terrace to a depth of some 12 m, and smaller individuals are found at shallower depths ranging up the fore reef slope and outer reef flat.

Several edible species of conchs inhabit the reef flats of Yap. Although their population densities are too low to support any commercial development, species in the genera Strombus and Lambis represent a valuable protein resource in the subsistence fisheries of the islands.

Twelve species of epifaunal bivalves were noted. Of these conspicuous bivalves, only the giant clams of the Family Triacnidae are harvested for human consumption. Infaunal bivalves, of which only dead remains were noted, appear to be more important in the traditional subsistence mollusc fishery.

Giant clams are represented by four species on the reef flats and shallow areas of the fore reef slope. These generally are the smaller species with wider geographic distribution and lower economic values. However, they are prized food species in the Yapese subsistence fishery. One of the larger species, Tridacna derasa, has been introduced for cultivation on the reefs near Rumung (Section 1). These clams will be distributed throughout the state during clam re-introduction projects.

The black-lipped pearl oyster Pinctada margaritifera is scattered on reef flats of Yap, often occurring in enclosed lagoon holes. Although the population density of pearl oysters is not high, their presence indicates that environmental conditions in Yap can support the species. Pending the results of a feasibility study underway in Pohnpei, pearl oysters may represent an economically valuable mollusc resource for Yap. These remain traditionally valuable as a form of Yapese money.

Of the marine crustacean species observed, spiny lobsters of the genus Panulirus are the most noteworthy because of their potential commercial value. Although the spiny lobsters are usually nocturnal, several individuals were observed during the day in enclosed lagoon holes and on the fore reef slope. Other crustaceans include infrequent observations of various crabs.

Echinoderms occupy most areas of the reef system of Yap. Suspension-feeding forms, such as ophiuroids and crinoids, inhabit many areas characterized by moderate water movement. Predatory species, including certain seastars, occur in areas of live coral in enclosed lagoon holes and the fore reef slope community. Grazers and deposit-feeding forms, such as sea urchins and sea cucumbers, occupy the reef flats and upper fore reef slopes.

The coral eating seastar Acanthaster planci is widely distributed on the reef system of Yap. However, it is not present in the large numbers observed during the epidemic irruptions of the early 1970's. One ocean terrace station that was inhabited by A. planci also supported the triton trumpet Charonia tritonis, which is a predator of the seastar.

Several species of the sea cucumbers with potential commercial value inhabit the reef flats and fore reef slope community. Of particular note are Holothuria nobilis and Thelenota ananas, which are the most highly valued species in consumer markets in the Orient. Actinopyga mauritiana and Holothuria scabra have lower values on a per pound basis, but they may be equal to the larger species in overall commercial value because they tend to be more abundant. Most of the remaining species have little or no economic value.

Ascidians such as Didemnum molle are nearly ubiquitous on the reefs of Yap. However, some species are present in restricted habitats. Didemnum candidum inhabits only the submerged prop roots of Rhizophora mangroves. Eudistoma cf. viride occurs in enormous numbers in enclosed lagoon holes on leeward reefs, but it is seldom observed elsewhere.

## SUMMARY

### FISHES

The fringing mangrove forest is a conspicuous and dominant feature of the nearshore reef flat, providing shelter and habitat for many reef fishes. During the YCRI field survey, six mangrove stations were completed, revealing a moderately diverse fish assemblage comprised primarily of juvenile individuals. Because the mangrove wasn't penetrated more than 2-3 meters (6-10 feet), many species were probably unobserved. Schools of juvenile fishes were observed at every station, with juveniles more common than adults. The most frequently observed families included Chaetodontidae (butterfly fishes), Lutjanidae (snappers), Apogonidae (cardinal fishes), Acanthuridae (surgeon fishes), Siganidae (rabbit fishes), and Gerridae (mojarras). Since mostly juvenile fishes were observed, this suggests the critical role and importance of mangrove forests as a nursery habitat for Yap's fisheries. Thus, it is necessary to sustain and conserve mangrove habitats to Yap's coastal fisheries from further degradation in the future.

Generally, the reef flat extending between the mangrove forest and the outer reef margin supports fairly diverse fish populations, but only in localized regions. These areas typically exhibit high live coral development with some vertical relief. Randomly distributed reef patches and enclosed lagoon holes possess the greatest diversity and abundance. The adjacent sand flats, however are depauperate with the exception of larger predator fish species cruising through during high tides.

The outer reef slopes and terraces generally have greater numbers of larger fish species than other reef zones. Often, very large schools of Acanthuridae (surgeon fishes), Scaridae (parrotfishes) and Lutjanidae (snappers) are observed there.

## SUMMARY

## OTHER MARINE VERTEBRATES

### Sea Birds

Birds were only incidentally noted during the YCRI survey. Several bird species range far over the ocean foraging and return to roosting or nesting trees located in the mangrove forests and interior native forests of the Yap Proper islands. Population densities are generally lower on Yap than in the other FSM States, which can be attributed, in part, to the low percentage of suitable nesting habitats available [29]. An important species utilized by local fishermen to locate schools of fish offshore is the Brown Noddy (Anous stolidus or Gapluwan regur) [29]. A similar species is the Black Noddy (Anous minutus) which also has the same Yapese name of Gapluwan regur [29]. The Black Noddy, however, forages within the lagoon while Brown Noddy's forage further out to sea. The White Tern (Gygis alba or Machich) feeds on small squid and fish taken by diving to the water's surface and appears commonly in the forests of Maap Island [29]. Additional information on Yap's marine birds can be found in publications by Pyle and Engbring [96] and Engbring et al. [29].

### Turtles (Weel)

Two species of marine turtles are widely recognized by fishermen throughout Micronesia. The green turtle (Chelonia mydas) is the most abundant species with moderate nesting colonies in outer coral and high islands of Pohnpei, Truk and Yap State [43,84]. Also observed commonly is the hawksbill turtle (Eretmochelys imbricata). This species occasionally nests in the outer islands of Yap and Pohnpei and occurs in relative abundance on nesting beaches in the Palau Islands [43,87].

In addition, two other species have been sighted on rare occasions. A mating pair of olive ridley turtles (Lepidochelys olivacea) was spotted in Miil Channel, on the leeward side of Yap Proper in 1973 [35]. A small olive ridley from Lamotrek Island in Eastern Yap State, was also reported by these authors. Periodically, a leatherback turtle (Dermochelys coriacea) is seen, although only encountered in deep waters. A young leatherback was tagged and released near Satawal Island, in eastern Yap State, by McCoy [84]. He also reports that a leatherback was caught and eaten by local islanders on Woleai in 1971.

**Turtle Feeding and Nesting Grounds**

Interviews with Yap's fishermen revealed that turtles feed continuously along Yap's nearshore seagrass beds. This observation supports the green turtle's feeding preference of being uniquely herbivorous among sea turtles [43]. Additionally, a concept suggested by Pritchard [94], that the distribution of green turtles coincides quite closely with the distribution of seagrass pastures, is also supported. seagrass species commonly consumed by green sea turtles worldwide and present in Yap are Thalassia, Cymodocea, and Halophila [69,43].

Fishermen also reported that smaller, more variable sized turtles are seen and caught near Yap Proper [this report, 85]. Because Yap has no nesting beaches, this could lend support to the suggestion that migratory behavior is particularly linked with herbivory, since the richest feeding grounds (notably seagrasses) are associated with shallow areas of coastal deposition [43]. While the nearshore seagrass beds of Yap Proper satisfy feeding requirements for the green turtle, typically, these areas do not coincide with the best nesting grounds.

Good nesting grounds require isolated, sparsely inhabited, predator-free island beaches such as those found in the Yap outer islands. Limited populations of large, reproductively viable male and female turtles colonize the nearshore waters of several Yap outer islands during mating season. During these periods, turtles are easily caught by Yap Outer Islanders during mating or while females are nesting on beaches [84,85,87]. Turtle eggs are often harvested whenever found, although infrequently since turtle islands are visited only on a monthly or annual basis [84,85,87].

Studies of turtle populations worldwide show a strong philopatry (return to a particular regional shoreline) and site-fixity (return to a particular beach area for mating and nesting [43]). Because of the lack of nesting on Yap Proper, it is reasonable to assume that the turtles feeding on Yap's seagrass pastures belong to a breeding population located elsewhere. The closest nesting grounds to Yap are the northern outer islands of Ngulu Atoll, located to Yap's south or Ulithi Atoll, to the north. Currently, however, there are no data available to link these two turtle populations as being related. In fact, a small scale tagging program on the outer islands of Pohnpei, reported recovery of a tagged Pohnpei turtle in Taiwan, indicating the regional role of FSM for a wide ranging Pacific Ocean turtle population [11]. The lack of nesting turtles on Yap Proper could be attributed to prolonged predation by man leading to the extirpation of breeding females.

Because the seagrass pastures of Yap probably serve as important feeding

grounds for a regional turtle population in at least Micronesia, it is recommended that these areas be designated as critical habitats and be protected from unnecessary degradation. Initiation of a turtle tagging program in both Yap Proper and the Outer Islands should be initiated to determine the migration routes of turtles between island groups. Data collection on sexual maturity and feeding preferences could also be incorporated into the program. Cooperative sponsorship of the program and involvement between the Yap Outer Islanders and Yap Proper residents would promote better understanding and conservation of this precious and endangered resource.

### Role Of Turtles In Subsistence

There is increased pressure on the turtle resource throughout Yap State because of greater populations, the emergence of a cash economy, and decline in traditional taboos [84,85]. In the district center of Yap Proper, McCoy has suggested that turtle catching and harvesting has evolved into a sport rather than a major protein contributor [84]. Interviews with fishermen during the YCRI, however, disagreed with McCoy's observation that catching turtles was purely a sport in Yap Proper. Rather, the fishermen reported that most of the turtles caught today are for special occasions and turtle is considered more of a delicacy. There was consensus among the fishermen that turtles do not serve as prominent a role in the lives of high islanders, as they do for atoll dwellers. Because the Yapese live on a high island, they have a variety of protein sources based on subsistence farming and lush nearshore fisheries. Females on Yap Proper do not require turtle shell belts for normal wear as do outer island women. Additionally, their introduction and proximity to a cash economy allows them to purchase canned products easily unlike the outer islanders.

### Yap State Conservation Laws

Several levels of jurisdiction prevail in Yap and for that matter in Micronesia, regarding conservation of marine resources. Traditional law, as vested in the hereditary leaders, prevails over legislation promulgated by the State government system according to the Yap Constitution. The Constitution also states that:

"No action may be taken to impair these traditional rights and ownership, except the State Government may provide for the conservation and protection of natural resources within the marine space of the State within 12 miles from the island baselines (Art. 13, Sect. 5.)".

Interpretation of this clause, therefore, seems to provide a mechanism for the State to assist in the management of marine species.

Where turtles are concerned, traditional law reflects ownership over turtle resources in a particular area, and the need to request permission from traditional owners before turtles can be harvested. In Yap State, the western outer islands of Pikelot (*Pik*) and West Fayu (*Pigailoe*) are turtle nesting grounds traditionally linked to Satawal Island [84,85,87]. The islands of Olimarao and Elato are primarily exploited by the islanders of Lamotrek and Elato [84,85]. Uninhabited Gaferut (*Fayu*) island also supports a turtle population and is harvested by Faraulep islanders [84,85]. Turtles congregate near the outer islands of Ulithi atoll where traditional customs are strong, and turtles are considered the property of the chiefs of Mogmog [84,85,87]. On Ngulu Atoll, located south of Yap Proper, turtles can only be killed by the chief of the atoll.

Recognizing the importance of turtles as a protein source for some factions of the FSM islanders, subsistence harvesting of turtles is permitted, although there are some restrictions. Micronesian law, as reflected in the FSM Code of Law (Title 23, Sec. 105), totally protects turtles during the nesting periods of June 1 to August 31 and from December 1 to January 31, inclusive. Additionally, no turtles may be captured on nesting beaches, including eggs. Furthermore, there is a minimum carapace length of 34 inches (86 cm) for green turtles and 27 inches (69 cm) for hawksbill turtles.

On an international level, both the green and hawksbill turtles are listed as "threatened or endangered species", which are in danger of extinction and whose survival is unlikely if the causal factors continue operating [43].

An analysis of these regulatory agencies and the question of resource ownership, clearly depicts a complex situation with many overlapping jurisdictions. In Yap and elsewhere in the Caroline and Marshall Islands, sea turtles were previously protected by the U.S. Endangered Species Act between 1973 (when the Act was promulgated) and 1986 (when the TTPI era came to an end in the FSM).

## SUMMARY

### ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Yapese historic sites have received archaeological study only for a decade (1978-1988), except for a 1956 project [42]. Work has included predevelopment contract archaeology [15,21,28,57,66-68,72,91-92] and research studies [14,17,16,50-56,58-59,107]. Recording of site locations and measurements, much less dating, is very limited to date -- an extremely important point for resource management concerns.

Yapese historic sites are usually discussed in the context of village settlement patterns. There were approximately 180 villages in the mid-1800s, when European contact intensified. Many of these villages had lands extending from the reef zones up onto the coastal flats and the adjacent tree-covered lower slopes or valley floors and then up through the higher savanna (grass and pandanus) slopes. On the reefs, the following historic sites are found: coral foundations of fishtraps in various shapes from mounds to arrow-shaped traps [50,52,54]. These fishtraps are patterned nonrandomly. Ruins of the villages' houses are usually on the coastal flats and adjacent tree-covered slopes or up the valley floors. These include numerous dwelling platforms (*daf or dayif*) (60-150 *dayif* estimated per village, in cases archaeologically studied) [16,54,59] and associated cooking houses (*taqang ko lum*), at least one meeting house (*p'eebaey*) and dance area (*malaal*), several menstrual huts (*dapael*), at least one sacred place (*taliiw*), sitting/rest platforms (*wunbey*), and stone paths. Young men's clubhouses (*faeluw*) are found on the seaward edge of the coastal flats or on fill extending partly offshore or completely offshore. Building foundations are nearly always elongated hexagonal platforms, and often they sit on larger rectangular platforms. *Malaal* usually have rectangular sitting platforms and displays of stone disc valuables (*raay, feaq*) located around an open dance area. Paths are often raised and occasionally have drainage gutters alongside. Most of these historic sites are made of schist and/or coral. Some house and p'eebaey sites are still in use, often with a modern structure on the old foundations. *Malaal* and paths frequently are still in use. Importantly, taro pond-field systems wander among these village ruins, with larger patches often near the shore. Some of the larger patches are said to be land reclaimed from the mangroves and/or the sea. Many of these systems, although still in use, are old historic sites.

Farther upslope, the savanna typically has remnants of extensive ditch-bed

yam garden systems. These are in the form of raised earthen beds with intervening drainage ditches. Often these ditches drain down into the upper part of the taro systems. Occasional sitting platforms (*wunbey*) are also present. Burials -- low, square or rectangular, stone pavings, which can be tiered -- are abundant on the beds of some garden ruins. Burials are said to occur in lower ranking villages. In addition to these site types, some villages had soil quarries for pottery manufacture.

For this inventory report and companion atlas, the obvious coastal resources on the reef flats are the marine exploitation sites (fishtraps) and the clubhouses (*faeluw*) often jutting offshore. However, village housing often was near the immediate shoreline in locations convenient for marine resource exploitation as well as farming. Mollusk, crustacean and fish remains from these sites potentially will yield vital information on marine resource exploitation. Also, considerable amounts of today's coastal flats and coastal taro swamps may be land reclaimed from mangrove swamps or shallow open lagoon.

So far, we have a very sketchy picture of Yap's prehistory. Dates from archaeological sites go back to ca. the B.C. 300s, indicating people have been on the island for at least 2,400 years. The origins of the early settlers is unclear. Linguists are still debating the origins of the Yapese language -- with northern New Guinea connections being investigated in the late 1970s. Very little is known about the culture, land use or settlement patterns during this early period.

In fact, archaeological information, at this point, reveals very little about Yapese prehistory up to about the A.D. 1400s-1500s. A few historic sites date before these times, and changes in pottery and some tools are indicated, but little details of settlement patterns and lifestyles are available.

By the mid-1800s, when intensive European contact began, we do know that about 26,000-34,000 people may have lived on Yap -- estimates gleaned from archaeological data [54]. This was an extremely large population; indeed, the densest of all the Micronesian high islands. Maximal population estimates for villages from this period have been computed based on dayif counts [16,54,76,101]. Highly intensive agricultural systems (the taro and ditch-bed yam systems) and marine exploitation systems (the fishtraps) were present. Serf villages were present, tied to certain independent villages. These serf villages were often located inland in extremely small villages with small populations. Independent villages were closely interlinked in complex, ranked, alliance networks. There were 10 district alliances, each dominated by a powerful village. Then there were three large alliance networks with Gachpar dominating the alliance network of Gagil, Meqruur and

Teab villages dominating those in Tamil, and Baleabaat and Ngolog ascendant in the south. Additionally, three exchange networks extended out from Yap. Gagil dominated a network extending out among the small islands (mostly atolls) to the east, a network which encompassed islands within today's Truk State. This eastern network was called the *sawei* [8,56,74,75]. A second network, also called *sawei*, extended west to Ngulu atoll and was dominated by Guroor village at the extreme southern tip of the island, an extremely powerful village [107]. The third outer island exchange system linked Ruul with Palau, where stone money (*raay*) was quarried [75].

These patterns of the mid-1800s did not simply spring into existence. They developed over time. But, little is known of the time depth or development of these patterns -- much less their causes. The surface archaeological sites (the types and patterns noted initially in this discussion) quite likely contain vital information on these concerns. Archaeological dates from a few such surface sites extend back into the A.D. 1400-s-1500s [42,54,59]. Yapese pottery has been found in outer islands to the east in deposits securely dated to the A.D. 1200s-1500s [38], suggesting some form of the eastern exchange network may date back to this time; and Jesuit interviews of islanders castaway in the Philippines in the late A.D. 1600s [46] suggest the network existed in close to its full extent in that century. Also, oral histories have been recorded which discuss how some of the serf villages were formed [16,22,75] and which describe some changes of rank among villages in the highly competitive village ranking structure [75,91]. However, these are only initial clues.

Clearly, much needs to be learned about Yap's past. Both archaeology and oral history will play vital roles in piecing together the past, a task that will benefit from close cooperation between scientists and Yapese oral history experts. Studying historic sites -- either prior to development or as pure research -- will be an important element in this undertaking. And, although the historic site types in or along the coastal resource zone are somewhat restricted, they can contribute much to understanding Yap's past.

## SUMMARY

### RESOURCE USES

An inventory of Yap Proper's coastal resources would not be complete without determining their present and possible future and past uses. However, written data on resource use on Yap Proper rarely exists. In this situation, current information on the utilization of known resources, has to be based primarily on interviews with knowledgeable local resource users and resource management personnel. A survey of coastal resource use in Yap Proper was undertaken as part of the YCRI project. The survey consisted of interview sessions with resource users and management personnel residing on Yap Proper. In addition, written documentation of coastal resource use was obtained whenever possible. These results produced a qualitative description of resource characteristics and uses on Yap Proper.

Most of Yap Proper's exploitable resources are found along its coastal areas. The most important of these resources occupy nearshore fisheries, mangrove forests, sand reservoirs, and coral reefs. Resources with the ability to attract tourists are also important. Interviews and record gathering focused on collecting information on the use of these important resources.

Fishery products includes marine life such as fish, shellfish, turtles, and octopus taken primarily for human consumption, but also for other purposes such as handicrafts. The intent of the survey was to determine the relative abundance and distribution of the primary fishery resources as perceived by local fishermen. Fisheries products are harvested for commercial as well as subsistence purposes, though subsistence is the predominant reason. Not surprisingly, the majority of interviews took place with subsistence fishermen. Yapese fishermen's knowledge of fish behavior, abundance, and distribution is extensive rendering them by far the best source of information on the resource.

Fish is the most important source of animal protein for the Yapese. A household survey conducted on Yap Proper in 1986 found that fresh (76%) and canned (9%) fish accounted for 85 percent of daily animal protein consumption in Yap, while chicken (11%) and pork (3%) accounted for only 14 percent [127]. Of the total amount of fresh fish consumed, 73 percent is from reef fish. In addition, about 91 percent of the total fresh fish catch is for home consumption while only 9 percent makes its way into the cash economy. This indicates that both artisanal and subsistence fishing are the most important means of delivering animal protein to the

Yapese dinner table. Based on the results of fisheries interviews, it's clear that Yap's lagoon reef fishing grounds are the most important protein producing area. Thus, the condition and productivity of these fishing grounds are "of great interest and concern to traditional fishermen of Yap, and of direct importance to the well being of the people" [31].

Based on interviews with local fishermen and with marine resource management personnel, the coastal fishery does not appear to be in immediate danger of decline. Fishermen are able to catch adequate supplies for personal consumption with some surplus to sell to retailers. The relatively high percentage of canned fish consumed is somewhat surprising considering that there is an adequate supply of fresh fish available. Other factors such as consumer status buying or preference for the oily flavor of canned fish may account for this. However, little or no information is available concerning consumer preferences in Yap.

The health of the lagoonal fishery may be attributed to the retention of traditional marine tenure practices [63,106]. Although too lengthy to discuss here, ownership of Yap Proper's lagoon and reef is divided among villages and individuals with rights to harvest fishery products attached [129]. This amounts to a limited access fishery, long noted as a prime method of preserving a fishery.

There are indications, however, that there may be problems with the coastal fishery in the future. During the YCRI interview sessions, local fishermen were asked if they felt that fishing was as good today as it was 10 years ago. In all ten municipalities, fishermen felt that fishing was better in the past. A 1987 MRMD survey of fishermen later confirmed these findings of the YCRI user's survey [128]. Without accurate estimates of fish stocks and catch per unit effort these perceptions are difficult to test quantitatively.

There are several factors which may be contributing to the suspected decline in Yap's reef fisheries. Causes include, but are not limited to a break down of traditional marine conservation methods, an increase in population and associated demand for fish, and the use of modern fishing gear [88].

Among these reasons, the use of modern fishing gears may be the most significant. The introduction and unregulated use of gill nets and the use of spear guns, especially with flashlights at night, may be particularly destructive. These methods according to the survey of fishermen conducted by the MRMD, are the most popular fishing gear used. A study to determine the impact of gill nets on the fishery conducted by MRMD is now under way [128]. The Council of *Pilung*

(Council of Traditional Chiefs on Yap Proper) have attempted to ban night spearfishing [33]. The MRMD has begun to implement monitoring and research programs necessary to insure the sustainability of the coastal fishery into the future.

Commercial fishing plays a small, but important role in the use of coastal resources. Though it makes up only about one-tenth of the total fish caught, it is one of the few income producing activities in Yap today. Kusakawa et al [73], estimated the volume of fish sold commercially in Yap to be approximately 300,000 pounds (lbs). Of that total approximately 94 percent was harvested in the waters around Yap Proper. Reef fish accounted for 58.3 percent of the commercial catch, deep bottom fish 16.6 percent and pelagics 25.1 percent. The commercial fishing sector has the potential to grow much larger as market channels are opened to fishermen and retailers.

The Yap Fishing Authority (YFA) was created by the State legislature to develop a commercial fishery. By agreement with the MRMD, YFA confines its activities to areas outside the barrier reef [39]. A review of the YFA statistics for the first five months of 1987 indicate that pelagic fish comprise 76 percent of the YFA's catch, while bottom fish make up the other 24 percent [99]. Because the YFA confines its activities to those areas not fished by local subsistence fishermen, their commercial activities should not have a major impact on reef fishing. Export markets developed by YFA will make it possible for artisinal fishermen that occasionally troll for pelagic species to sell their fish.

### Fishing Methods

The Yapese fishermen employ a number of techniques to harvest fishery products. Falanruw and Faimau [34] have identified traditional fishing methods used in Yap, while the MRMD has identified 14 types of fishing methods/gears used by local fishermen today [128]. The main methods used are: nets (gill net, and surround net), spear fishing, (day or at night with flashlight), and handlines. Trolling and scoop nets were used to a lesser extent but for specific kinds of fish.

Stone and bamboo fish traps are still used, but their use has declined in recent years. Because modern fishing gear are relatively inexpensive and easy to obtain, many stone traps have fallen into disuse [52]. Some of the traps are now being used in combination with gill nets according to local fishermen interviewed. The stone traps are built in such a way as to aggregate fish into the nets.

Two different types of nets are used: gill nets and surround nets. Gill nets are set in a location for a period of time (usually the tidal cycle) and harvested later.

Surround nets are used to surround schools of fish and haul them to shore or on a boat or raft. Gill nets are the most frequently used fishing net.

Spearfishing is done with either a spear gun using a steel shaft and surgical rubber or a pole spear with a triple-pronged head. Spear fishing is done both in the day or at night with a flashlight. More reef fish are caught spear fishing than with any other method [128].

A handline is simply a hook attached to a line held in the fisherman's hand. When a strike is made on the hook, the fisherman jerks the line and pulls the fish in. Fisherman use handlines while standing along the ocean reef's edge and inside the lagoon [128].

Trolling is done from a moving fishing vessel seaward of the ocean reef. A line is paid out from the vessel's stern and pulled through the water by the boat. The line can be attached to a rod and reel or be held by the fisherman. In general, pelagic fish species are caught by trolling using power boats [128].

**Aquaculture**

There is some evidence that stone enclosures used for aquaculture existed on Yap in the past. A recent survey by Nelson [88] concludes that there is little or no aquaculture ongoing today. The potential for small scale subsistence aquaculture exists according to Nelson. If the population continues to increase and the reef fishery resources decline, this type of aquaculture may become more desirable. Nelson [88] makes several recommendations for species and methods of extensive culture which could be used on Yap.

**Tourism and Resort Development**

The ability to attract tourists is not a coastal resource per se, but a potential future value or function. The idea is that the suitability of a coastal area for recreation, resort, and tourist development depends on a number of diverse elements some of which are natural resources. These include the absence or presence of beaches, unique marine habitats of interest to divers, historical or cultural sites, and the area's bathymetry and topography. Other non-resource factors such as the adequacy of roads, and availability of services should also be considered. Locations along Yap's coast were judged against this amalgam of elements to determine the potential for recreation, resort, and tourism development.

Yap's year round warm weather, spectacular diving, traditional culture, and

regular commercial airline connections makes tourism development a viable area for economic growth. There are a number of visitor attractions including World War II fortifications and derelict Japanese warplanes, the Maap cultural center at Bechyal, and stone money banks throughout the island. Yap State would like to promote tourism. In 1985 tourism officials commissioned a comprehensive tourism plan for Yap state [26]. The plan outlines a strategy of small scale village-oriented tourism development. However, Yap State tourism officials seem to be adapting a more conventional approach to tourism development. This perspective includes investigating the development of resort hotels through joint ventures and creating the infrastructure necessary to support tourism, while educating the public to be more receptive to visitors [40].

**Fill Materials**

Materials needed for constructing infrastructure such as roads, and piers, and for other facilities necessary to build a more modern Yap, must come primarily from reef and lagoon areas. Several projects, particularly road paving throughout Yap Proper and filling to create land for public purposes, will require an enormous amount of dredge materials and sand. Dredging for these fill materials has occurred at various reef locations throughout Yap. Each of these sites will be briefly discussed in the sectional inventory to follow.

**Mangrove Forests (Malil)**

The coastline of most Yapese villages are lined with mangrove forests. These forests are selectively harvested for termite resistant wood on a subsistence basis throughout the island [32]. Only one unconfirmed report of harvesting mangrove hard wood for commercial purpose was received during the survey. However, a report by the U.S. Soil Conservation Service states that small scale logging of forests in Yap could take place on a sustainable basis [115]. Whether commercial harvesting on any scale is advisable should be carefully studied.

## SUMMARY

## WATER QUALITY

### General

Water quality standards for the FSM were adopted from the standards established by the TTPI's Environmental Protection Board in 1972. The TTPI standards are use-based and classifies insular water resources into one of three classes according to how they will be used. The three classes AA, A, & B and their associated allowable uses are shown in Appendix G. Generally AA waters are to be maintained in as nearly their natural, pristine state as possible with an absolute minimum of pollution from any sources. Class A waters are maintained at the next highest level for recreational purposes and aesthetic enjoyment with waters being kept clean of trash, solid materials and oils. Waters classified as B are used for small boat harbors, commercial and industrial shipping, bait fishing, and compatible recreation. The objective for this classification is for all discharges to receive the best degree of treatment practiced under existing technology. Minimum allowable levels of pollution are set within each of these classes and the pollution level is measured by a set of eleven environmental parameters within each class. These parameters include: total coliform, fecal coliform, total nitrogen, total phosphate, total nitrogen divided by total phosphate, dissolved oxygen, total dissolved solids, salinity, temperature, and turbidity. Pollution levels in excess of any of these parameters is considered a violation of the standard for that class.

The water quality classifications for coastal water throughout Yap are shown in Appendix G. The majority of coastal waters are considered to be in pristine or near pristine conditions with the exception of unclean waters and activities in the Colonia harbor region [30]. A water quality study conducted by the Water Resources Research Center at the University of Guam [18], examined fourteen sites around Yap to establish a bascline water quality data set and to identify specific areas which were in violation of water quality standards [18]. In eleven of the fourteen sites, the water quality was within the standard for all parameters. In the other three sites, two in the waters around Colonia and the other in Fanif in Northern Yap island, levels of total coliform and fecal coliform were in excess of minimum allowable levels. No more recent quantitative information on Yap's water quality could be identified during the YCRI survey, although visual snorkeling observations provided insight in some instances.

**Sources of Pollution**

Pollution normally enters receiving water from point or non-point sources of discharges. Point source discharges are from a single identifiable source such as sewage outfalls, over-the-water toilets (benjos), or pigpen discharges. Non-point source discharges have no single identifiable source of pollution discharge. Examples include rain water runoff during heavy rains, chemical leaching from road surfaces, and leachate from filled lands. A survey of pollution surfaces on Yap Proper was conducted in 1979 by a task force from the TTPI Environmental Protection Board [30]. Not surprisingly, most of the point and non-point sources occurred in the area around Colonia. Most other areas were found to be free of point source discharges.

Both water quality classification and source pollution will be briefly described in the sectional analysis.

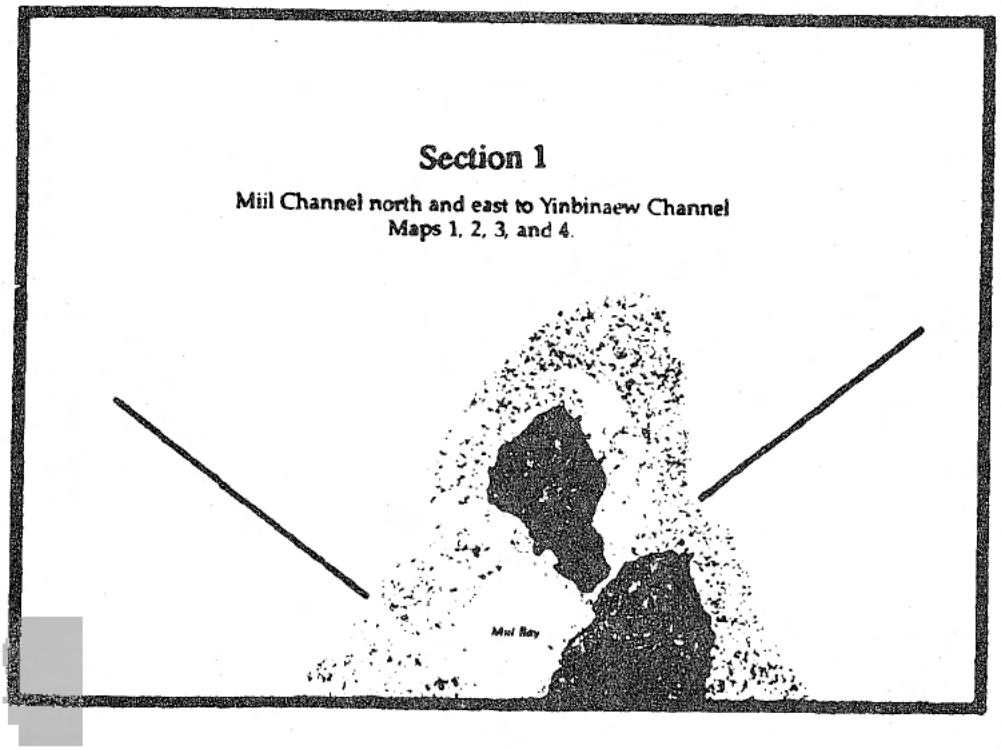
## SECTION 1: RUMUNG ISLAND

### GENERAL DESCRIPTION

Rumung is the northernmost and smallest island of the Yap group featuring both windward and leeward coastlines. The paramount municipality is Rumung with the only exception being Qamin village, located at the southern end of the island, and under the jurisdiction of the neighboring municipality of Maap. The southwestern coastline is adjacent to the Miil Channel embayment (Figure 5).

During the Japanese administration, a coral rock bridge was constructed to connect the two islands of Rumung and Maap. It was destroyed, however, by the typhoons of 1946 and 1947 and never replaced [65]. The cleared unpaved road continues to extend along the shoreline close to the mangrove forest. The only bridge remnants are several large mounds of coral which are exposed at low tide, but are unmarked navigational hazards at high tide for unfamiliar boat operators. Today, as in the past, Rumung is accessible only with a resident's invitation and by small boats.

FIGURE 5. A MAP OF SECTION 1 WHICH INCLUDES ONLY RUMUNG ISLAND.



This isolation has allowed Rumung to remain virtually untouched by modern conveniences. Instead, the islanders have elected to retain the most traditional subsistence lifestyle on Yap. Unlike the other Yap complex islands, there are no cars or electricity. Daily activities include subsistence farming and fishing offshore of the island. The windward coastal plain is the most populated area on Rumung. The island has a total population of 130 [116].

## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

The island of Rumung encompasses all of Section 1 and is the northernmost and smallest of the four islands of the Yap Proper complex. It is a diamond shaped land mass roughly 3.4 kilometers (2.1 miles) long, 2.1 kilometers (1.3 miles) wide, and about 4 sq. kilometers (1.6 miles) in area [65]. Rumung is made up of rounded steep hills which slope directly down to the mangrove forest or reef flat. The highest peak, Qadirqel, is 84 meters (280 feet) with most averaging between 50-60 meters (200 feet). An extremely narrow coastal flat is located at the northernmost end of the island between the villages of Riy and Gaqnaqun. Otherwise, steep cliffs or scarps, 5-10 meters (16-33 feet) in elevation, skirt the coastline. Isolated pocket cobble sand beaches are found on the northwestern side of Rumung between the villages of Bulwol and Gaqnaqun. Fourteen short, intermittent streams flow into the adjacent reef flat and mangrove areas; none, however, empty into a major drainage basin.

### Fringing Reef

A fringing reef of varying width surrounds the entire island of Rumung. Its average width is 1 to 1.5 kilometers (0.9 miles), extending to 2.5 kilometers (1.5 miles) at the northernmost end of the island and narrows to 150 meters (500 feet) wide in Yinbinaew Channel which separates Rumung from Maap Island. On the windward reef flat, twenty enclosed lagoon holes span the length on the island in various shapes and sizes. Likewise, the leeward side of Rumung also has several small enclosed lagoon holes that dot the reef flat. The predominant feature on this side, however, is the Miil Channel embayment which bisects the reef flat and delineates the northeastern boundary of Section 1 from the boundary of Section 7.

### Mangrove Forest (Malil)

The mangrove belt is fairly narrow around Rumung Island. It is completely absent on the leeward side except for a small cove just south of Meechoqol village. On the windward side, however, a narrow belt, less than 200 meters (666 feet) wide, bounds most of the coastline. Small boat passages penetrate the mangrove stands which are adjacent to some villages.

Section 1

**Reef Flat**

A combination of sand, silt, and rubble comprises the nearshore fringing reef flat with little or no live coral coverage. During low tides, vast expanses of the nearshore reef flat are completely exposed. A band of sand and silt 1-3 meters (3-10 feet) wide generally occurs at the edge of the mangrove stand. Typically, this zone extends outward with a mixture of seagrasses of varying densities and also low coral microatolls. Silt is the predominant substrate, except in the narrow Yinbinaew Channel between the islands of Maap and Rumung. A shallow limestone bench encases a portion of the western Rumung shoreline near Bulwol.

In most places, a shallow reef flat platform extends out to the fringing reef edge with substratum composed primarily of sand and eroded reef rock. As the distance seaward from the mangrove stands and shoreline increases, less silt is found. In some locations, such as north of Miil Channel, a zone of predominately calcareous sand with scattered coral mounds and thickets occur in 2-3 meter (6-10 feet) depths in the deep back reef flat. Together, the shallow water depth and complex coral patches restrict small boat passage at the northern end of Rumung to the 4-6 hour period bracketing high tide.

**Enclosed Lagoon Holes (Makef)**

Numerous enclosed lagoon holes occur within Section 1, but they are predominantly located on the windward reef flat. Their dimensions and configurations vary considerably, the largest being approximately 1100 meters (3666 feet) in length and the smallest just under 50 meters (166 feet). Wide reef flat extensions penetrate many and there is no common shape found among all.

On the seaward edge of the windward enclosed lagoons (YCRI Stations 2a, 2b, 3a,), there is minimal to no coral growth. Typically, the adjacent reef flat is composed of extensive sand flats (90 percent) with isolated patches of scoured reef rock. Continuous wave energy driving water across the reef flat has facilitated the transport of sand into the reef hole, thus creating a talus chute and slope. The landward portion of the reef hole margin, however, is completely rimmed by coral development. Conversely, on the leeward side of Rumung, the enclosed lagoon holes are entirely rimmed by coral including stout microatolls on the seaward side.

On the leeward lagoon reef slope, both coral coverage and species diversity are high. The upper 4-6 meters (13-20 feet) are gently sloped, although irregularly,

with topographic relief of several meters in places. Huge coral blocks have slumped in places with the dominant substrate being coral. Vertical relief increases with depth to steeply sloping mounds, ledges, and pinnacles at roughly 15 meters (50 feet). Below this, sand and sediments predominate. Elsewhere in the lagoon hole, sand and sediments begin at shallower depths (5-8 meters).

Coral coverage is variable along the windward lagoon reef slopes. On the seaward talus slopes, corals are conspicuously absent with the exception of isolated coral mounds and pinnacles. Massive coral heads and platform thickets, often protruding 4-5 meters above the sand bottom's surface, provide the only topographic relief on these steeply sloped sand surfaces. On the landward side of these lagoon holes, however, coral coverage becomes moderate and gently slopes to the sand bottom at a depth of 10 meters (33 feet). Massive coral mounds rise to within 2 meters of the surface along the boundary of the enclosed lagoon. Typically, small depressions of sand patches up to 8 meters in diameter, are surrounded by shallower coral mounds and thickets.

**Miil Embayment and Patch Reefs**

The Miil Channel entrance is very narrow and easily discernible at low tide because the channel margins are completely exposed. The meandering channel opens up into a tremendous embayment also called Miil. Six large patch reefs are located within the boundaries of the embayment. All are submerged at low tide with only 1/2-2 meters (1.5-6 feet) of water covering the flat top of each reef. Fanowaeg, a triangular shaped patch reef, is located adjacent to the mouth of the Miil Channel and was surveyed during the YCRI Station 18c activities. The patch reef's sides were completely blanketed with a diverse and abundant assemblage of coral species to the channel's sediment floor. The upper margin of the terrace is characterized by high coral coverage (80 percent) and diversity with mostly branching species. Moving off the narrow terrace, large massive unattached coral heads on the wall merge with encrusting and foliaceous species, achieving 50 percent live coral coverage. The proximity of this patch reef to the channel's ocean entrance, assures good water circulation and recruitment of biota to the reef's substrate. Thus, the high species diversity can be attributed, in part, to the patch reef's geographical location within the channel. Investigations of the other patch reefs located within the interior of Miil embayment would probably support this

statement.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

The outer reef flat is seaward of the lagoon holes and embayments where present, or is the outer half of the reef flat. Its margin is a veneer of low to moderate coral coverage of microatolls and low, branching corals over a reef rock pavement. Patches of coral rubble and sand are interspersed. A huge reef block (> 4-5 meters in height) deposited on the reef margin, probably during a typhoon, serves as a good landmark for fishermen off Rumung's west side. Closer to the outer edge of the reef flat (reef crest), the reef flat is shallower and composed primarily of solid reef rock layered with rubble and algae, which is frequently exposed during low tides. Small current rills etch the hard pavement which develop into very narrow surge channels (greater than 1 meter in width) at depths of 1-4 meters (3-13 feet) offshore. Seaward of Miil Channel, the semi-leeward hard reef substratum gradually slopes to greater depths with little topographical relief.

Moving north to the windward side of Rumung, the reef edge is also composed of hard limestone with sand patches and a few low microatolls. Continuous wave energy along this coastline has led to the development of a spur-and-groove system along the ocean fore reef slope of all windward reefs.

**Ocean Reef Slope (Waru'e naa')**

**Ocean Slope**

Along the leeward coastline of Section 1 (YCRI Stations 18, 1, and 2), the fore reef gradually descends at a 15 degree angle to greater depths, terminating in wide terraces at depths of 15-18 meters (50-60 feet). Coralline algae is abundant in the shallower depths (1-3 meters) with low to moderate (1 meter) coral relief overall. Further down slope, coral coverage ranges between 40-60 percent on hard substrata with a higher species diversity. In scattered sand depressions, coral coverage decreases to only 10 percent. Table corals, primarily Acropora spp. account for approximately 25 percent of the total coral coverage.

The geomorphological representation of the windward coastline of Section 1 (YCRI stations 3,4) represents a high wave energy system with a well defined spur and groove system, particularly at YCRI Station 4. The tops of the reef spurs extend seaward to a depth of 5 meters (16 feet) while some groove channel bottoms

are as deep as 12 meters (40 feet). Relatively moderate to high coral coverage blankets these channels characterized by primarily stout and robust species and forms of corals.

At depths of about 10 meters, these buttresses or spurs diminish and the channels widen, and begin to coalesce into a gradually sloping (15 degree) terrace at a 20 meter (66 feet) depth. Seaward of these buttresses (spurs), coral coverage remains moderate to high (60 percent), consisting primarily of corymbose, branching, and foliaceous (plate-like) whorls of coral of moderate species diversity. An occasional ocean reef pinnacle, reaching heights of 3-5 meters (10-16 feet), projects above the predominant terrace of lush coral growth. Unlike the leeward side, there are no sand deposits.

**Reef Pass (Dubchol)**

The only ocean reef pass in Section 1 is Miil Channel and its adjacent embayment which includes the YCRI Station 18b. Stout microatolls and hard current and wave resistant reef rock pavement, fortify the margin of Miil Channel. The narrow channel entrance shoals landward to about 5 meters (16 feet) before terminating as the steep, vertical walls of the inner embayment. Little coral colonizes these outside walls other than encrusting forms which veneer the wall leading into the embayment.

Section 1

## FLORA

### Fringing Reef

**Mangrove Forest (Malil)**

The mangrove belt is fairly narrow around Rumung Island. It is completely absent on the leeward side except for a small cove just south of Meechoqol village. On the windward side, however, a narrow belt, less than 200 meters (660 feet) wide, bounds most of the coastline. Small boat passages penetrate the mangrove stands which are adjacent to some villages.

**Reef Flat**

There is normally a narrow (width 2 to 5 meters) band of sand and silt, followed by the beginning of seagrass beds at the seaward edge of the mangrove stands. The seagrass (predominately Thalassia hemprichii and Cymodocea rotundata) beds are generally thick and verdant in this Section, and extend 50 to 200 meters (165-660 feet) seaward on the fringing reef flat. The seagrass Enhalus acoroides is only common adjacent to the mangrove (YCRI Station 2b).

A number of algal species live among the seagrasses and also beyond the seaward limits of the seagrass beds, forming a variable algae zone. Some green algae (Halimeda macroloba and Caulerpa racemosa) are common on the sand-mud flats. The rather brittle red alga, Laurencia parvipapillata, is also common near the mangrove.

**Enclosed Lagoon Holes (Makef)**

Commonly found just at the base of dead Acropora coral branches are the red algae Gelidiopsis intricata and Polysiphonia spp. seaward of the lagoon hole (YCRI Station 2a). Tsuda [110] also reported that Polysiphonia was the dominant alga in this Section's lagoon holes a decade ago.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

The algal community becomes sparse near the margins of the reefs and lagoon holes, leaving a relatively barren zone of sand, rubble, and solid reef rock (including microatolls) along the reef ridges.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

No live macroalgae specimens were observed during the YCRI survey. Skeletal evidence of Halimeda sp are scattered throughout sand patches of the northern, leeward ocean reef slope. Calcareous red algae dominate the upper, shallow faces of the spur and groove system (Less than 7 meters (23 feet)). Encrusting coralline alga are found commonly among the cracks and crevices of the reef corals.

Section 1

## CORALS

### Fringing Reef

**Reef Flat**

The inshore portion of the fringing reef flat exhibits very low coral diversity, with coverage ranging between 0-5 percent. The distribution and abundance of coral on the inner reef flat is primarily influenced by the discharge of freshwater and silt from the adjacent terrestrial systems. Additionally, the presence of unstable sand and rubble deposits discourage colonization by coral assemblages. The dominant coral observed is Porites lutea microatolls which are often haphazardly intermixed with the seagrass beds, but also occur to seaward of the seagrasses. Small, thin branching colonies of Pocillopora damicornis are often seen too.

Seaward, the shallow outer reef flat platform merges with a zone of hardened reef rock veneered with sand and rubble. Scattered about this zone are isolated coral patches and thickets with moderate coral coverage averaging 10-20 percent. Elsewhere, the substrate is suitable for thickets of branching Acropora palifera, on hard substrates, staghorn coral A. acuminata over soft sand, and the finger coral Stylophora pistillata on hard surfaces to flourish along the back reef margin.

Seaward of the seagrass zone, the reef flat's shallow depth limits the upward growth of corals. Small massive colonies of Favia, Porites, Diploastrea, and Montipora form localized bands of high coral coverage. In several places throughout the reef flat, mushroom corals (genus Fungia) are well represented.

**Enclosed Lagoon Holes (Makef)**

There's a pattern for coral coverage to be high (75-80 percent) with irregular relief along the upper margin and slopes of all holes. As discussed previously, the coral development in lagoon holes varies depending upon the geographic location on the windward or leeward side of the island complex. On Rumung's leeward (west) side, the rims of the lagoon hole are completely surrounded by a solid framework of coalesced living corals. Along the hole's upper margins and lips, massive Porites microatolls and stout corymbose Acropora are dominant. Coverage is high despite being exposed at low tides. On Rumung's windward (east) side, the lagoon holes have coral growth primarily on the landward side featuring mostly microatolls. The seaward reef hole margin and slope however, consists mostly of

sand and a sand talus as a result of sediment transport across the reef due to wave action and currents from a seaward to landward direction.

A highly diverse coral assemblage typically characterizes the upper reef slope. Columnar colonies and the finger coral Porites cylindrica dominate although other ramose and staghorn species such as Acropora, Goniopora, Acrhelia, and Seriatopora are present. Further down slope, common corals include the foliaceous Pachyseris rugosa, explanate plates with projecting fingers of Pectinia paeonia, various mushroom corals (Fungia), and small heads of Cyphastrea. Sand and coral rubble dominate the lagoon floor's substrate except for randomly distributed staghorn Acropora thickets or other massive coral colonies.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

Sand and coral rubble form a extensive veneer over areas of the outer reef flat which has only 0-10 percent live coral cover. Both the windward and leeward sides exhibit localized patches of dense, low branching Acropora with 30-50 percent coverage. As in other back reef areas, vertical coral growth is restricted by the low tide limits which creates a collar-like barrier to the open ocean. This zone of coral relief, sometimes 1 meter (3 feet) high, occurs further towards the outer reef flat margin and gradually merges into the smooth consolidated reef margin platform. The reef flat framework has a similar composition as the lagoon hole margins with stout ramose Acropora and large Porites microatolls being abundant. Seaward, calcareous algae cements together and/or out-competes other low cropped corals for substrate. Loose materials are abundant and are thrown up from the ocean fore reef by waves and are abraded and cobble-sized. When moving from the reef flat to the outer reef edge and high wave energy zone, live coral coverage diminishes rapidly. In this zone, scoured reef pavement and shingle dominate the substrate.

**Ocean Reef Slope (Waru'e naa')**

**Ocean Slope**

The ocean slope topography changes gradually with increasing depth on both the leeward and windward ocean reef slopes. A formation unique to exposed windward reef is the spur and groove zone located on the northern windward ocean fore reef and which extends to a depth of 12 meters (40 feet). At the reef margin, hard substratum veneered with calcareous algae and low to moderate relief (1

meter or 3 feet) descends gently (at a 15 degree slope) to greater depths and increasing coral cover. Dense patches of the zoanthid, Palythoa, occur infrequently in this transition zone between the shallow reef flat and the first deeper terrace. Typically, the terrace exhibits extremely high coral diversity and coverage. Species of corymbose Acropora are the most obvious and abundant corals. Moderately high ridges and mounds are created by Favia, Porites, Oulophyllia, Leptoria, and Diploastrea corals. Other foliaceous and cryptic encrusting corals colonize hard substrates which enhance the complexity of the existing topography. This gradually sloping terrace continues seaward into deeper depths

**Reef Pass (Dubchol)**

Miil Channel cuts the outer reef flat margin of Section 1 and also delineates the southern leeward boundary of this Section (YCRI Station 18). The ocean reef slope fronting the sides of this pass resemble those previously discussed. The moderately sloping reef has hard substratum with low relief on the fore reef. Quickly this transforms into a highly diverse zone with coral coverage averaging 60 percent further down slope. Table Acropora is the most conspicuous and dominant coral. Other common corals include fire coral (Millepora), organ-pipe coral Tubipora, and the brain corals Favia, and Platygyra. Along the reef face in the passes, coral cover is usually low due to the tidal current scouring the walls. Consequently, encrusting species become more prominent.

## OTHER INVERTEBRATES

### Fringing Reef

**Mangrove Forest (Malil)**

The periwinkle Littorina scabra is present in the mangrove formation adjacent to Rumung. The snails can be found commonly on the prop roots, stems, and leaves of the mangroves.

### Fringing Reef

**Reef Flat**

The predominant macrobenthos colonizing the limestone pavement of the reef flat are soft corals. Lobophytum spp. are the dominant organisms occupying a zone approximately 3 meters (10 feet) in width along the outer portions of the reef flat. Shoreward of this zone is a similar zone, roughly 4 meters (12 feet) in width, that is dominated by Sinularia spp. Colonies of Cladiella sp. and Xenia sp. are scattered elsewhere on the reef flat in areas exposed to currents. In what must be considered marginal habitat for the species, Sympodium sp. (yellow color) was also noted in the area.

The zones of Lobophytum spp. and Sinularia spp. provide habitat for the only species of echinoderm (the pin-cushion sea star) observed on reef flats in this Section. This coral reef asteroid Culcita novaeguineae commonly occupies the substrate near the base of the soft coral colonies.

Although sponges are present on the reef flat, their abundance and diversity are low. A black sponge and brown sponge were encountered.

Molluscs comprise a conspicuous and diverse component of the reef flat macrobenthos. In areas with a substrate of limestone pavement, the sessile vermetid Dendropoma maxima was abundant, both on the pavement and in association with coral colonies of Porites and Millepora. The common spider conch Lambis lambis is found on rubble substrate on the reef flat. The tiger cowrie Cypraea tigris takes refuge in recesses of large rocks. The outer reef platform near Rumung supports an abundant population of juveniles of the giant clam species Tridacna maxima.

In areas characterized by sand substrate, infaunal gastropods are abundant. Despite their burrowing habits, these snails are conspicuous because of the characteristic furrows they create as they move through the sand in search of food.

At low tide, some species emerge and forage on the surface. Detritivorous snails such as Rhinoclavis vertagus and Mitrella ligula are very abundant in sandy areas of the reef flat. Rhinoclavis fasciata is also a common member of the infaunal snail assemblage. The herbivorous conch Strombus gibberulus is occasionally encountered, as are predatory snails such as Conus eburneus, Terebra affinis, and Terebra maculata. These and other infaunal molluscs fall prey to the drilling gastropod Polinices tumidus, which also inhabits the sandy substrate.

**Enclosed Lagoon Holes (Makef)**

Reef slopes of enclosed lagoon holes provide habitat for a diverse assemblage of macrobenthos. Stylotella agminata, a medium-sized orange sponge, is the most commonly encountered species, and it varies from abundant to occasional in the lagoon hole communities of this Section. A black sponge occurs in this habitat, but it is found in smaller numbers. An encrusting brown sponge appears to be restricted to a single lagoon hole, as do two species of testillid sponges.

Cnidarians other than scleractinian corals exhibit very high diversity on reef slopes of enclosed lagoon holes. Octocorals are predominant among this group, both in species diversity and biomass. Soft corals of the genus Sinularia are present in the greatest abundance. However, the stoloniferan Clavularia sp.# is more widespread. Anthelia sp., a soft coral, was commonly observed in one lagoon hole in this Section, but it was not encountered at any of the other stations in this survey. Occasional specimens of Sarcophyton spp. and Xenia sp. can be found in the upper reaches of this habitat. Stereonephthya spp. and Lobophytum spp. are present, but rarely encountered. The clownfish anemone Heteractis crispa is scattered in crevices on the slope.

Two species of suspension-feeding polychaete annelids are conspicuous in this zone. The sabellid feather-duster worm Sabellastarte sanctijosephi is the more ubiquitous species, perhaps because of its less restrictive substrate requirements. The serpulid Christmas-tree worm Spirobranchus giganteus attains greater population densities, but this species is limited to a substrate of Porites spp. coral heads.

The lagoon hole reef slope supports a considerable number of mollusc species, but individuals within the species are not abundant. The sessile vermetid

gastropod Dendropoma maxima is the most common and widely dispersed species. Other gastropod species include Trochus maculatus, Lambis lambis, and Lambis truncata.

Bivalves are relatively more diverse than gastropods, but they are present in smaller numbers. Of these, the boring ark shell Arca ventricosa is encountered occasionally in burrows on oblique surfaces of coral colonies and limestone reef rocks. The coral-boring scallop Pedum spondyloideum can be located in massive Porites coral colonies. Four species of economically valuable bivalves occupy this zone. The giant clams Tridacna maxima, Tridacna squamosa, and Hippopus hippopus can be found here, but each is rare. The black-lipped pearl oyster Pinctada margaritifera is present, but is also considered rare.

Echinoderms are represented on the lagoon hole reef slope by the boring echinoid Echinostrephus cf. aciculatus, which is common in limestone substrate. The sea cucumber Thelenota ananas, which is a valuable fishery species, dwells on rubble near the base of the slope, and Bohadschia graeffei can be observed feeding on the mucous film covering the coral Porites cylindrica.

The ascidian Didemnum molle is widely distributed among the enclosed lagoon holes. This species ranges from occasional to abundant on coral rubble and limestone reef rocks on the lagoon hole reef slope.

The lagoon bottom is characterized by a scarcity of epibenthic invertebrates because there is little refuge from predators. The volcano-like sand mounds produced by callianassid shrimps are the dominant feature of the lagoon bottom. Where currents are absent and sediments are fine, the benthic jellyfish Cassiopea medusa can be found. Two seastars, Linckia multifora and Fromia sp., may be present on the lagoon bottom at its confluence with the reef slope. The most conspicuous invertebrates of this habitat are the sea cucumbers Synapta maculata and Bohadschia argus, which are encountered occasionally and rarely, respectively.

**Reef Islet**

Intertidal rocks at the edge of the reef islet are occupied by large numbers of a grapsid crab. In the moat adjacent to the reef islet, sponges are the major invertebrates present. Occasional specimens of a brown sponge and the orange sponge Stylotella agminata inhabit the moat zone. A black sponge may be encountered, but it is rare. The seagrass meadow bordering the moat supports a

population of the humped conch Strombus gibberulus.

A notable feature among the intertidal rocks is the large number of valves of the giant clam Hippopus hippopus. The presence of such large numbers of valves indicates clam population densities and harvest intensities far greater than those observed during this survey.

**Ocean Reef Slope (Waru'e naa')**

Octocorals constitute the major component of the macrobenthos of the fore reef community. The stoloniferan Clavularia sp. is abundant and widely distributed. Sinularia spp. are the predominant soft corals in terms of population density, but Xenia sp. is the most widespread, ranging from occasional to abundant on the fore reef slope. Colonies of Sarcophyton sp. are occasionally observed.

Other cnidarians of the fore reef slope include the clownfish anemone Heteractis magnifica which is scattered in limestone recesses in this zone. Occasional specimens of the zoanthiniarian Palythoa sp. can be observed throughout the zone.

The serpulid Christmas-tree worm Spirobranchus giganteus is the only conspicuous polychaete of the fore reef community. These suspension-feeders can be found on coral colonies of Porites and Montipora.

The commercial topshell Trochus niloticus is the most common gastropod of this zone. These large snails, which constitute an important fishery resource for the insular Pacific, range from common to occasional on the ocean terrace. Another relatively large marine snail, the turban shell Turbo argyrostomus, can be observed in the reef framework in this zone. Large numbers of shell fragments of this species littered the floor of grooves crossing the fore reef slope, indicating a sizable population of this cryptic snail exists on Rumung's reefs. The predatory snail Drupella elata was observed feeding on the coral Montipora sp. The tiger cowrie Cypraea tigris also occupies this zone, but it is rarely encountered. Occasional individuals of the nudibranch Phyllidia sp. can be observed throughout the community.

Giant clams are the only conspicuous bivalves of the fore reef community. Tridacna maxima is the more common species, and it is scattered throughout the zone. Tridacna squamosa is present, but it is rare.

Asteroids are the predominant echinoderms of the fore reef community.

Linckia multifora is the more common species, occurring on both the fore reef slope and the ocean terrace. Its congener, Linckia guildingi, is present but rare. Two species of coral-eating seastars occupy the fore reef. The crown-of-thorns seastar Acanthaster planci is encountered occasionally, and the cushion star Culcita novaeguineae is present, but in low numbers.

Sea urchins are not common in this habitat. The slate-pencil urchin Heterocentrotus mammillatus was the only echinoid species observed.

The ascidian Didemnum molle is widely dispersed on the fore reef slope. This species ranges from common to occasional on limestone substrates on the reef slope.

Section 1

## FISHES

### Fringing Reef

**Mangrove Forest (Malil)**

The mangrove forests of the windward side of Rumung provide abundant shelter for larval and juvenile fishes. Several species of snappers (Lutjanidae), cardinal fishes (Apogonidae) butterfly fishes (Chaetodontidae), rabbit fishes (Siganidae), and damsel fishes (Pomacentridae) were observed along the margin of the mangrove forests during the YCRI surveys. Darting among the mangrove prop roots are small belonids (Platybelone argalus platyura). On rare occasions juvenile acanthurids were observed, particularly Acanthurus blochii, the white-barred surgeon fish. These fishes were usually abundant at the outer mangrove edges. Observations generally did not penetrate more than 2-3 meters (6-10 feet) into the mangrove.

**Reef Flat**

The reef flat, extending between the mangrove or shoreline to the outer reef margin, generally lacks significant vertical relief due to vertical growth restrictions placed by daily tidal fluctuations. Closest to the shoreline, the resident fish population consists of small or juvenile fish species such as wrasses (Stethojulis bandanensis, Thalassoma hardwickii, T. amblycephalum, Halichoeres trimaculatus), surgeon fishes (Acanthurus triostegus, A. xanthopterus, Zebrasoma scopas, Ctenochaetus striatus) and damsel fishes (Chromis viridis, Stegastes nigricans, Pomacentrus pavo, Dascyllus aruanus). Seaward, both the diversity and abundance of fish increases, but is concentrated at isolated coral patches and thickets. Typically, fish from fourteen different families are encountered including the rabbit fish (Epinephelus merra), grouper (Siganus spinus), several species of parrot fishes (Scarus spp.), butterfly fishes (Chaetodon spp.), trigger fishes (Balistidae), and surgeon fishes (Acanthuridae). These fishes generally associated with various reef structures including large coral heads and thickets. The reef complexes which have extensive voids, irregular framework and some overhangs, provide extensive habitat types for various species. During higher tides, solitary and migratory species cruise along the reef flat interface foraging. These species include jacks (Carangidae) and small sharks (Carcharhinidae). Yapese fishermen also report observing turtles foraging throughout this Section.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The fish assemblage associated with the ocean reef slopes increases tremendously compared with the fringing reef flat. The YRCI survey identified 26 different families including 9 families of highly favored food species for the Yapese. The complexity of the reef habitat produces many more habitat types including, large coral pinnacles with coral overhangs, vertical cracks and ledges, and complex multi-specie coral formations. The most species diversity occurred in the families Acanthuridae (surgeon fish) with 14 species and Scaridae (parrot fishes) with 9 species, followed by Holocentridae (squirrel fishes) and Balistidae (trigger fishes).

Habitat preference continue to determine the location of most fish species. Fishes that generally school in the middle to upper water column include fusiliers (Caesio spp. and Pterocaeresio spp.), jacks (Caranx melampygus, Gnathanodon speciosus), and snappers (Lutjanus gibbus, L. monostigmus, L. bohar, Aphareus furca). Closely associated with the coral reef framework are smaller fish species. Butterfly fishes (Chaetodontidae) are the most abundant and diverse family of small fishes with small schools of Hemitaurichthys polylepis (pyramid butterfly fish; as seen on the cover of this report) being well represented. The damsel fishes are among the most numerous fishes on the ocean reef, being either territorial or rarely leaving the vicinity of their home coral patch. Several Chromis spp. appeared to be abundant, while occasionally seen damsel fish species included Dascyllus reticulatus, Plectroglyphidodon dickii, P. lacrymatus, Pomacentrus philippinus). Wrasses are also conspicuous fishes along the ocean reef terrace with the genera Anampses, Cheilinus, Epibulus, Gomphosus, Halichoeres and Thalassoma being well represented. Nocturnally active squirrel fishes of the genera Myripristis rested underneath ledges and small coral caves during the day. Edible species observed on the reef included larger parrot fishes (Scarus spp), groupers (Serranidae), trigger fishes (Balistidae) and sweetlips (Plectorhinchus spp.). A single grey reef shark (Carcharhinus amblyrhynchos) was observed off Station 1 while a large manta ray was observed foraging just outside of Miil Channel.

## OTHER MARINE VERTEBRATES

Green sea turtles (Chelonia mydas) are known to inhabit the ocean and lagoon waters of this Section. Although only one turtle was observed (YCRI Station 18), local informants state that turtles are seen feeding and resting on the seagrass beds surrounding Rumung. Furthermore, the turtles are known to migrate through the enclosed lagoon holes on the northeastern reef flat. An unidentified pod of porpoise was observed offshore of YCRI Stations 17 and 18.

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

In the mid-1800s, Rumung villages were linked to those of Gagil in the alliance networks. Archaeological work on Rumung is almost non-existent -- limited to one very brief survey in association with several community development projects [67]. However, a detailed social anthropological study in the village of Faal in 1947-48 has provided a map of house sites, p'eebaey, and faeluw locations and has gathered important oral historical information on Rumung's past [101]. In brief, the recording of historic sites on Rumung is virtually non-existent. We have no excavated sites or archaeological dates from the island. This means that coastal sites and the nature of reef resource exploitation over time are unknown for Rumung.

Section 1

## RESOURCE USES

Fishermen from Rumung and Maap Islands provided information on the type, uses, abundance, and location of resources harvested in this Section (Appendix F). Fisheries resources are considered to be abundant overall.

### Terrestrial

Land crabs (*galip*) are found in great abundance around Rumung and northern Maap, but are seldomly harvested any more. They were once exported to Guam, but low prices paid to the fishermen forced the discontinuance of this practice.

### Fringing Reef

#### Mangrove Forest (Malil)

A narrow mangrove belt fringes most of the windward Rumung coastline , but is completely absent on the leeward side except for a small cove just south of Mecchoqol village. Mangrove harvesting for local building projects continues on a small scale as it has been done for hundreds of years.

#### Reef Flat

Seaward of the coastline and mangrove forest are lush seagrass pastures which ring the nearshore areas of Rumung Island. Historically, turtles were observed regularly feeding and resting among the seagrass beds. Large groups of turtles seemed to move from the windward seagrass beds to the adjacent enclosed lagoon holes. Local fishermen reported that they had previously caught turtles quite frequently in these lagoon holes, but not within the last ten years. Furthermore, they revealed that turtles are seen only occasionally today and the catch has declined drastically with only a few being caught.

The fringing reef is considered an especially good fishing ground. Silver fishes (*qachwoq, qanger*), flagtails (*faakeayaan', liyeq*) and other juvenile fishes are caught close to shore. These species are either consumed or used as baitfish. Mullet (*quloch, galaed*) schools are also found migrating through the nearshore reef area. Seaward, fishermen reported catching a variety of fishes near lagoon holes and among complex coral assemblages. These fish include snappers (*gooychaaf, gadaw*) parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*quum, maath, machagwog, bilaew*), squirrel fishes (*yooch*), rabbit fishes (*dayit, garmiy, buywod*),

goat fishes (*manguch, mbing, soong*) and rudder fishes (*guumiy*). Generally, spear fishing, surround netting and gill netting are the most popular fishing methods employed. Occasionally mud clams (*yungwol*) are also harvested in these areas by hand.

There are a large number of stone fish traps scattered along the nearshore reef flat surrounding Rumung. Most fish traps indicated on the YCRI Atlas are actively utilized to harvest fish. However, the markings along the reef only indicate the approximate location of the traps.

Urban development has progressed the most slowly on Rumung because of the municipality's desire to retain their traditional life style. Hence, there are no dredge sites proposed, nor are there any existing dredging sites within this Section. Furthermore, no tourism development is currently planned for Rumung because of the absence of electricity and accessibility to the island. The lack of infrastructure makes Rumung less desirable for tourism according to the Yap State Tourism Division [40].

**Enclosed Lagoon Holes (Makef)**

All of the lagoon holes are used for fisheries. Emperor breams (*wul', qoeyeq, gadgad*) are caught along the lagoon hole edges, while angel fishes (*qeer, buloch*) and wrasses (*numean*) are caught on the reef hole slope. For these species, spear fishing and gill netting are the most frequently used methods. As mentioned earlier, numerous turtles have been caught in these lagoon holes, but the catch has declined drastically in recent years.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

Most of the outer reef flat has been identified as valuable for local fisheries, with many species being harvested by fishermen. Local fishermen identified isolated coral patches scattered throughout the reef flat as important fishing grounds. Fish species typically caught here are surgeon fishes (*quum, maath, bilaew*), parrot fishes (*qelbad, qalaabal, malngoed)*, rudder fishes (*guumiy*), and trigger fishes (*wuuq, moelngith, nguuf*). Squirrel fishes and box fishes, however, are caught more frequently along the edge of Miil Channel. Gill nets, surround nets, and spear fishing are the preferred fishing methods, with groupers (*smaak'uw, k'uw*) being caught with a handline. Lobsters (*qaraangoey*) and octopus (*k'aay*) are also

harvested in these areas by hand or with a spear.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The ocean reef fisheries are abundant and diverse. Fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*machagwog, maath, bilaew*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), and goat fishes (*manguch, mbing, soong*). Gill nets and spear fishing are the preferred fishing method, with groupers (*smaak'uw, k'uw*) being caught with a handline. Snappers (*gooychaaf*) are caught on a handline at the reef edge. Barracuda (*maal'*) and rainbow runner (*foofow*) are both caught by trolling along the ocean slope. Other species also caught trolling, but farther offshore are tuna (*taguw*), dog-tooth tuna (*yasul*), wahoo (*malchath*), and dolphin fishes (*dabaar*). These species are only harvested occasionally.

Topshells or Trochus (*yogyog*) are found along the seaward reef's margin as are lobsters (*qaraangoey*) and octopi (*k'aay*). Some harvesting of Trochus (*yogyog*) is being done for subsistence food needs. Many, however, collect yogyog during a MRMD regulated harvesting season to be sold to a commercial buyer as mother-of-pearl for jewelry and button making industries.

## WATER QUALITY

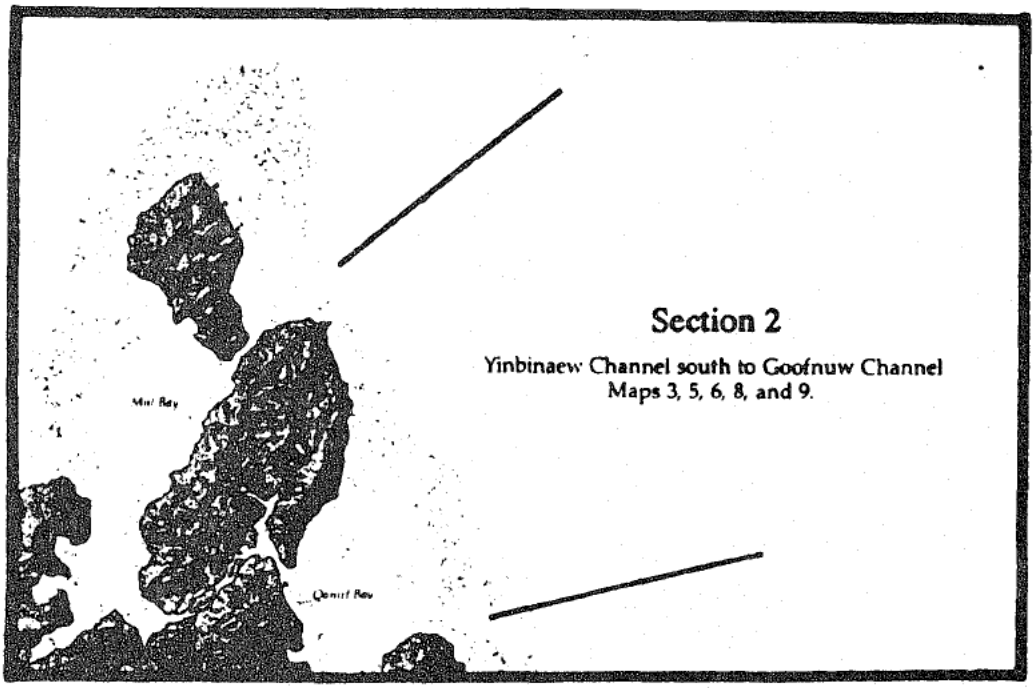
No point sources were observed in Section 1 and the coastal waters of Rumung are considered to be in their natural state without any man-made effects. There are probably some discharges from over the water toilets and pigpens along the coastline. Non-point sources, however, include some small gardening, soil preparation, and small boat discharges. The coastal waters are classified as "AA" with the exception of waters next to a recreational beach along the shoreline between Gaqnaqun and Qeng which are classified as "A"; the isolated beach area in Rumung is classified as "A" also; everywhere else is "AA".

## SECTION 2: MAAP ISLAND

### GENERAL DESCRIPTION

The entire island of Maap comprises Section 2 (Figure 6). It is the second smallest island of the Yap Proper island group and represents only the Municipality of Maap. The leeward coastline borders the inner Miil Channel embayment while the southeastern windward coast fronts Goofnuw Channel and Qaniif embayment. The longest stretch of white sand beach in Yap is found along the windward shoreline. Most of Maap's population (319) reside in scattered villages along the coastline. An unpaved road extends north from Tamil-Gagil island to the village of Wanead where it ends. Access to villages north of Wanead is along a cleared forest pathway.

FIGURE 6. A MAP OF SECTION 2 WHICH INCLUDES ONLY MAAP ISLAND.



## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

The island of Maap is 4.2 kilometers (2.6 miles) wide, 5.8 kilometers (3.6 miles) long, and about 10.6 sq. kilometers (4.1 sq. miles) in area [65]. Like Rumung Island to the north, Maap is also uniformly dissected, but by three ridges oriented parallel in a north-south direction. These ridges rise between 50-70 meters high with the two highest peaks located on the northwestern and central part of Maap. Ridge tops and hills in the interior are rounded while at the coastline they transform into nearly vertical cliffs 5-10 meters (10-30 feet) high.

Both the east and west coasts have narrow, discontinuous coastal flats 1-2 meters (2-6 feet) above high tide. A band of calcareous sand and terrigenous materials forms a beach that is 5-50 meters wide, which skirts the eastern coast from Tooruw to Choqol villages. In most other areas, the inland margin of the coastal flats are marshes, at least part of the year. Coastal flats on the windward side are free of mangroves while the leeward coastline is mostly fringed by mangrove forests. Maap's primary drainage system consists of the broad valleys which contribute as tributaries to an embayment called Munguuy that divides southern Maap into two peninsulas. Other streams flow to the coastal region, although their flow may be intermittent during the seasonal dry months.

### Fringing Reef

The fringing reef of Section 2 surrounds the island of Maap in varying widths. The windward side exhibits the widest reef flat (1700 meters) closest to Goofnuw Channel while it narrows to 1000 meters at the northern end of Maap by the village of Bechyal. The reef flat narrows considerably more on the leeward coast because it borders the Miil Channel embayment. Here, the reef flat width averages 300 meters; however, at Yinbinaew passage which separates Maap and Rumung Islands, the channel width is only 150 meters (500 feet).

Numerous reef features are found on the reef flat, particularly on the windward side. Goofnuw Channel penetrates the seaward reef flat edge and opens into a huge lagoon embayment called Qaniif. Several patch reefs are randomly distributed throughout the embayment. Just north of the Qaniif embayment are several enclosed lagoon holes, including one of the largest found in Yap called Laeneachoqol. A network of narrow, shallow, mangrove lined channels separate

the southern end of Maap from the northern end of Gagil-Tamil island before reopening into the Miil embayment area on the leeward side. Two small islands are found offshore of Maap on the fringing reef: Dilmeet and Pelau.

**Mangrove Forest (Malil)**

Narrow, discontinuous belts of mangrove border the leeward shorelines. At the northern end of Maap by the village of Bechyal, the stand is densest and up to 150 meters (500 feet) wide. Isolated pockets extend up to 300 meters (1000 feet) inland just north of the villages of Woriilaq and Palaa while at the Yuneanawey passageway and in Munguuy Bay between Maap and Tamil-Gagil, the stand is most developed. Patches of mangrove are found on the offshore island of Pelau. As mentioned previously, no mangrove forests occur on Maap's eastern coastline.

**Reef Flat**

On the windward nearshore reef flat, a 2-6 meter (6-20 feet) band of fine calcareous sand and terrigenous sediment borders the sandy beaches of Maap. This zone quickly merges with varying concentrations of seagrass and sand. Further offshore is an occasional, isolated live coral microatoll. This area is exposed completely during low tide. From north of Choqol village and roughly 200 meters (666 feet) from the shoreline, a hard reef rock platform extends seaward to the reef margin edge. Along this wide flat expanse, sand is the predominant substrate with occasional patches of hard reef rock. Large monospecifc staghorn coral thickets rising 1 meter (3 feet) high are widely distributed through the central reef moat in depths of 2-4 meters (6-12 feet).

Closer to the outer reef margin, the reef becomes more shallow and a pavement of cemented coral rubble, robust corals, and coral microatolls. Continuous water movement over this region assists in scouring and transporting fine sediments into the remnant lagoon basin. Closer to the margin of Goofnuw Channel, the reef flat is poorly developed. This may be due to strong tidal wave sheets and drainage into and out of the lagoon, preventing coral recruitment and settlement in the area.

As mentioned previously, the reef flat narrows substantially between the Maap-Tamil-Gagil island passage. In most places, the reef flat is not discernible due to deep silt deposits (0.5 meter). There are some small dead and living

microatolls in the center of the channel, whereas mangrove stands, up to 200 meters (666 feet) wide, fringe both the windward and leeward shorelines of Maap Island. Shallow channel depths restrict vessel passage during low tides while a low bridge connecting the two islands, does so at high tides.

On the leeward side of Maap, the reef flat borders the interior (inner) reaches of the Miil Channel embayment. Offshore of the mangrove shoreline, a narrow silty band merges with dense seagrass pastures interspersed with sand and some coral rubble. Moving gradually seaward toward the Miil Channel margin, the abundance of microatolls steadily increases as sand and seagrass abundance decreases as the water depth decreases to only 1 meter or less. More frequently, patches of scoured reef rock are found with small sand deposits. The predominance and influence of terrigenous sediments remain high along the channel's inner edge, with some Porites lutea heads exhibiting mucus secretions and bleaching along the reef flat margin. During low tide, significant expanses of the landward reef flat are completely exposed. A 2-3 meter (6-10 feet) band of densely packed microatolls exists along the channel margin.

The northern passage of Yinbinaew, which separates the two islands of Rumung and Maap and delineates the boundary between Section 1 and 2, is also fringed with mangrove. The narrow, shallow channel restricts vessel passage to high tide periods, and randomly distributed dead microatolls and coral heads provide navigational hazards. Remnants of an old coral bridge connecting Maap and Rumung islands grace the northwestern entrance to the passageway. As in the other channels, silt is the predominant substrate material.

**Enclosed Lagoon Holes (Makef)**

South of Choqol village, the seagrass and sand zone extends to the perimeter of the huge enclosed lagoon hole called Laeneachoqol. Microatolls and robust corals rim the hole's landward side while a sandy flat and talus slope comprise the seaward margin.

Within Laeneachoqol, there are ten recognized pinnacle/patch reef areas. A boomerang shaped pinnacle reef known as Taqayin, located on the landward half of this hole, was sampled as YCRI Station 5b with coral coverage ranging between 35-50 percent. Staghorn coral thickets dominated the sand covered terraces while finger, foliaceous, and massive coral species dominated the elevated portions of the

pinnacle. Within this region, water depths average 2-10 meters, but are probably deeper elsewhere.

**Reef Islet**

Two small islets are found off the coast of Maap on the fringing reef flat. Pelau, located off Maap's southwestern end, is an elliptical island about 136 meters (450 feet) in diameter. The top is rounded and about 8 meters (25 feet) above sea level at its highest point. A small stand of mangrove encompasses this island. A cliff about 3 meter (20 feet) high bounds the island. Located off Maap's northernmost end is Dilmeet, an irregularly shaped island located less that 50 meters from shore. Dilmeet has an elevation of 5 meters (15 feet) and a small plantation of coconut trees [65,36].

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

Moving seaward from the back reef flat, the outer reef flat margin shows a biota less diverse and abundant as it merges into a flat, wave-inundated platform. Along the outer reef flat, isolated coral assemblages of massive species and staghorn thickets predominate, giving topographic relief to the otherwise flat area. Further seaward, low, live microatolls become moderately abundant (in 1 meter depths) with rubble and shingle deposits becoming ubiquitous near the surf zone.

**Ocean Reef Slope (Waru'e naa')**

**Ocean Slope**

The fore reef slope and ocean terraces of Section 2 (YCRI Stations 5,) are blanketed by a carpet of extremely diverse and abundant reef corals (90-100 percent coverage). Unlike Section 1, there are no spur and groove formations in the classical sense. Rather, the spurs are wide and covered by reef corals while the channels are shallow and gently sloping. This feature descends gradually, converging with a more irregularly shaped terrace before descending to greater depths (>15 meters; 50 feet).

In shallower depths (3-5 meters or 10-20 feet), a combination of pavement and massive and corymbose coral species comprise the coral fauna. Seaward, however, various forms of reef corals are present. Stout Acropora table corals and thickets, or platforms of staghorn Acropora intermix with other irregularly shaped

massive species such as Porites sp. At greater (and calmer) depths (>15 meters), a highly diverse coral community of massive, incrusting, ramose, and foliaceous species occurs.

**Reef Passes (Dubchol)**

The northern backwater area and the outer wall of Goofnuw Channel were surveyed during the YCRI Station 6 activities. A short, narrow terrace at a depth of 3 meters (10 feet), occurs at the base of the top margin of the channel wall. Beyond this terrace, the wall drops steeply and nearly vertically at 80-90 degrees to roughly 12 meters (40 feet) where a talus slope descends deeper.

The upper margin of the terrace is characterized by high coral coverage (80 percent) and diversity with mostly branching species. Moving off the narrow terrace, large massive unattached coral heads on the wall merge with encrusting and foliaceous species, achieving 50 percent live coral coverage. The talus slope exhibited a variety of coral forms probably due to corals slumping or tumbling downslope from shallower depths. Overall coverage was only 25 percent.

Section 2

## FLORA

### Fringing Reef

#### Mangrove Forest (Malil)

Narrow, discontinuous belts of mangrove border the leeward shorelines. At the northern end of Maap by the village of Bechyal, the stand is densest and up to 150 meters (495 feet) wide. Isolated pockets extend up to 300 meters (990 feet) inland just north of the villages of Woriilaq and Palaa. The stand is most developed at Yuneanawey passageway and in Munguuy Bay between Maap and Tamil-Gagil Islands. Patches of mangrove are found on the offshore island of Pelau. As mentioned previously, no mangrove forests occur on Maap's eastern coastline.

#### Reef Flat

A wide band of seagrasses extends offshore of both the windward and leeward coasts of Maap. Thick, verdant beds of Thalassia hemprichii and Cymodocea rotundata reach 100-300 meters (330-990 feet) seaward on the fringing reef flat. Tsuda and Belk [111] reported a bed of Enhalus seagrass in 1-2 meter (3-6 feet) depths between Rumung and Maap Islands. Algae intermixed with the Enhalus included green algae Halimeda gigas, and Neomeris vanbosseae and the brown algae Dictyota apiculata and Padina minor [111].

#### Enclosed Lagoon Holes (Makef)

During the YCRI survey, no macroalgae were observed in Laeneachoqol hole (YCRI Station 5b). Calcareous skeletal remains of the green algae Halimeda spp. was found in the sand although no live specimens were observed. Due to similarities with other lagoon hole environments, it's probable that the red algal genus Polysiphonia is present.

### Ocean Reef Slope (Waru'e naa')

#### Ocean Slope

The top and upper ocean slope (depths less than 5 meters (16 feet) of the barrier reef are dominated by crustose coralline algae.

## CORALS

### Fringing Reef

#### Reef Flat

Very limited coral growth appears on the inner reef flat which encompasses the mangrove, seagrass and reef flat interface. Coverage is generally limited to less than 5 percent and often much less than one percent to 2 percent. Terrestrial freshwater and silt, low tide reef flat exposure, and unsuitable sediment substrate all restrict coral development. For instance, on the eastern side of Maap Island boarding Miil Channel, there are extensive reef flat areas, several hundred meters wide, which are partially or completely exposed during low tides. Coral growth is scarce within these regions and on similar areas throughout Yap. When coral does occur on the sand, rubble, and silt of the inner reef flat, it is usually scattered Porites lutea microatolls.

Towards the outer reef margin, the reef platform increases in depth. The northern windward portion of Maap Island has sand flats that extend out to the reef margin. Scattered thickets of arborescent Acropora and small coral heads provide the only relief to this otherwise depauperate area. Here coral coverage is greater, ranging from 5-20 percent whereas elsewhere, there is no coral.

#### Enclosed Lagoon Holes (Makef)

There are only three enclosed lagoon holes in Section 2. The largest hole called Lacneachoqol was partially surveyed (YCRI Station 5b) and focused on an area near a "boomerang"-shaped pinnacle reef and its adjacent habitats. The average coral cover ranged between 35 to 50 percent for the three different habitats on the reef. The pinnacle's seaward side has a sand terrace with staghorn Acropora thickets and small heads of Porites cylindrica and P. lichen colonies. Other intermixed corals included Seriatopora, Montipora, Favia, fire coral (Millepora) and Favites. Dominating the elevated portions of the pinnacle are Acropora acuminata and heads of Porites cylindrica. Other common corals found are Fungia (mushroom coral), Favites abdita, and Stylophora pistillata. The pinnacle's landward side comprises a small terrace which also descends to a fine sand bottom. Along the sand, yellow-colored staghorn Acropora acuminata thickets comprise the dominant substrate with Acropora also being the dominant coral genus. As in other windward lagoon holes, the seaward margin consists mostly of a sand reef flat and

sand talus slope.

### Inner Embayment

Along the inner reef margin of Qaniif and Miil embayments, a veneer of silt covers calcareous reef rock with less live coral than elsewhere on the outer fringing reef flat. A shallow platform extends seaward from the shoreline and is completely exposed during low tides. Coral populations virtually disappear next to the mangrove (less than 1 percent cover). A living Porites lutea microatoll, however, was reported within 3 meters (10 feet) of the mangrove stand. Heavy mucus secretions and some bleaching from Porites lutea microatolls on the reef flat bordering Miil Channel, however, suggests evidence of sediment stress (YCRI Station 18c). Within 30 meters (100 feet) of the channel edge, pancake-shaped Porites lutea microatolls and small Favia and Montipora conicula mounds become the dominant substrate with 10 percent coverage. Coral cover along the channel wall's slope ranges between 35 to 50 percent in these silt laden waters. Few species colonize the interior walls other than Favites, Favia, Porites, and Montipora. Below 6 meters (20 feet), silt and coral rubble are the predominant substrate down to the channel's bottom.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The gently dipping seaward slope of the reef flat leads to a sloping ocean terrace with 90 to 100 percent live coral cover. Wide spurs are covered with low-relief corals such as stout table Acropora and small mounds of Leptoria, and Favia. Complimenting the ridges are shallow, gently sloping surge channels that are also carpeted by corals. From the bottom of this buttress system, an irregular terrace extends into deeper waters with Acropora as the dominant genus. Throughout the terrace, overall coral coverage is close to 100 percent. A staghorn Acropora zone is intermixed with foliaceous Galaxea, Echinopora, encrusting Montipora, and lobes of Hydnophora and Platygyra. Further downslope, this zone merges with massive Porites heads, 3-4 meters (10-13 feet) in diameter, at a depth of 12 meters (40 feet). Below this, small, highly diverse knolls blanketed the terrace with ramose Acropora irregularis (of which an Acanthaster planci [crown-of-thorns starfish] was feeding on), encrusting Favia, finely branching Stylophora, and massive Porites colonies.

This zone continues to slope gradually to the drop-off zone.

**Reef Pass (Dubchol)**

The nearly vertical wall of Goofnuw Channel (e.g. YCRI Station 6) generally has less than 50 percent coral cover and is characterized by three zones. The upper channel wall and the surrounding reef flat margin has high coral coverage, roughly 80 percent, with many diverse branching species. The diverse coral community includes ramose Pocillopora, Acropora, and heads of Diploastrea, Leptoria, and Favia. Large brain coral heads of Lobophyllia and vertical plate-like branches of the blue coral, Heliopora coerulea, appear to be precariously balanced on a narrow ledge 3 meters (10 feet) deep. At the wall's edge, foliaceous Echinophyllia and columnar colonies of branching Porites (S.) rus dominate the wall's floor (at about 11 meters [35 feet]) before merging with a talus slope. On the sediment dominated talus slope, coral coverage averages close to 25 percent, but decrease to no live corals with depth and along the channel's bottom. In areas where the pass slope is less steep and more irregular along the interior portions of the channel, coral diversity remains moderate. Overall coverage may vary from 40 to 60 percent at depths of 10 meters (33 feet).

Section 2

## OTHER INVERTEBRATES

### Fringing Reef

**Mangrove Forest (Malil)**

Mangrove formations of Maap provide habitat for the periwinkle Littorina scabra and the cerithiid Clypeomorus pellucida. Littorina scabra is abundant supratidally, occurring on prop roots, stems, and leaves of the mangrove Rhizophora. Clypeomorus pellucida is abundant subtidally on prop roots of the mangrove tree Rhizophora and on pneumatophores of the mangrove tree Bruguiera. The crab Grapsus sp. can be observed on supratidal branches of Rhizophora.

Adjacent to the mangroves is a narrow zone of fine silt substrate. The detritivorous snail Cerithium coralium is abundant in this zone. Shells of dead Pyrene varians and Strombus luhuanus litter the substrate.

The seagrass meadow abutting the silt zone is occupied by two species of sea cucumbers. Holothuria scabra is the more common species. Holothuria atra is present but rare.

**Reef Flat**

Reef flats of Maap have abundant populations of a black sponge and a small tan sponge. Both species are associated with seagrass communities. Stylotella agminata is encountered occasionally in areas of limestone pavement and reef rock.

Cnidarians other than corals are notable for their near-absence on Maap reef flats. The soft coral Sarcophyton sp., which is common, is the only species of alcyonacean present. A large individual of the anemone Stichodactyla gigantea was associated with a reef rock.

The sabellid worm Sabellastarte sanctijosephi is the only conspicuous polychaete encountered. This species is common on the reef flat.

Molluscs are the most diverse faunal element of the reef flat. Seagrass meadows support the densest populations of gastropod molluscs. The cowries Cypraea annulus and Cypraea moneta are abundant on the sand substrate, while Pyrene varians is abundant on the seagrass blades. Occasional individuals of the conch Strombus gibberulus are encountered on soft substrates. Cerithium zonatum, Strombus mutabilis, Lambis lambis, and Conus miliaris are present, but rarely encountered.

Hard substrates provide habitat for occasional individuals of the sessile vermetid Dendropoma maxima. The tiger cowrie Cypraea tigris is present, but it is rare.

The coral-boring scallop Pedum spondyloideum is the only epibenthic bivalve encountered. Occasional individuals can be found embedded in coral colonies of Porites. Valves of dead Gafrarium pectinatum, an infaunal venerid clam, littered soft substrates in the seagrass meadow.

A large Dardanus megistos was observed in the seagrass community. This hermit crab carried a Lambis lambis shell for refuge.

Reef flat echinoderms are diverse and conspicuous. Ophiocoma sp., a black suspension-feeding ophiuroid, is abundant in crevices in limestone pavement. The asteroids Culcita novaeguineae and Echinaster leuzonicus are associated with rubble and hard substrates, where they can be found occasionally.

The burrowing echinoid Echinostrephus cf. aciculatus is present in limestone pavement and reef rock. This species is observed occasionally on the reef flat.

Sea cucumbers are associated with sand substrates. Holothuria atra and Stichopus chloronotus are commonly encountered, along with occasional specimens of Holothuria edulis.

The ascidian Didemnum molle is abundant on the reef flat. This species occupies rubble and reef rock substrates.

**Miil Channel Patch Reef**

Sponges comprise the major element of the invertebrate fauna in this habitat. An encrusting brown sponge is abundant on patch reefs in Miil Channel. Medium-sized colonies of a black sponge and the orange sponge Stylotella agminata are commonly encountered. Occasional colonies of brown sponges and gray sponges may be found.

The patch reef also provides habitat for a large stinging hydroid, Aglaophenia cupressina, which can be found scattered in this zone. Soft corals of the genus Sinularia are abundant, and the stoloniferan Clavularia sp. can be found scattered on hard substrates. The clownfish anemone Entacmaea quadricolor may be encountered here.

Polychaete worms are represented in this habitat by the feather-duster Sabellastarte sanctijosephi. This species, with its tentacular suspension-feeding

apparatus protruding from its parchment-like tube, may be encountered on hard substrates.

Molluscs are represented on the patch reef by bivalves; no conspicuous gastropods were noted. Pedum spondyloideum is abundant in Porites coral colonies along the upper margin of the patch reef. The ark Arca ventricosa may be found in its burrows in reef rock. The giant clams Tridacna maxima and Hippopus hippopus are encountered on patch reef flats.

Echinoderms are rarely observed on the channel patch reef. The asteroid Fromia sp. and the sea cucumber Holothuria edulis were the only species encountered.

Tunicates make up a conspicuous community in the patch reef environment. The ascidian Didemnum molle is abundant along the upper reef margin, and clusters of Eudistoma cf. viride are scattered on dead corals.

**Mid Channel Margin**

The channel margin provides habitat for numerous sponges. Common species are a black sponge and an encrusting gray sponge. An encrusting brown sponge and the orange sponge Stylotella agminata are also found in this zone.

Cnidarians other than corals and annelids are each represented on the channel margin by single species. The wire coral Cirrhipathes sp. is present but rare, and the feather-duster worm Sabellastarte sanctijosephi is scattered on rocks along the margin.

Suspension-feeding bivalves are the only molluscs of this habitat. The hammer oyster Malleus regula, the coral-boring scallop Pedum spondyloideum, and the thorny oyster Spondylus cf. squamosus are abundant among rocks and coral heads. The cockscomb oyster Lopha cristagalli and the boring ark Arca ventricosa are scattered along the margin.

Echinoderms exhibit the greatest diversity of macrobenthos on the channel margin. The asteroid Culcita novaeguineae may be found on silt-covered limestone pavements. Protoreaster nodosus is present in the sparse seagrasses bordering the channel margin, but it is rare here. The urchin Echinometra mathaei is abundant in its grooves in dead coral heads. An unidentified sea cucumber, Actinopyga sp., is also abundant in the recesses of reef rock. Occasional individuals of the sea cucumbers Actinopyga miliaris and Holothuria edulis may be encountered on soft

substrates, while Holothuria flavomaculata is present but, rare among the rocks.

The ascidian Didemnum molle is common in the channel. These tunicates inhabit reef rocks along the channel margin.

### Ocean Reef Slope (Waru'e naa')

Octocorals are relatively diverse on the fore reef slope, but they are not abundant. The soft coral Sarcophyton sp. is locally common but not widely dispersed. Sinularia spp. and Xenia sp. are widely distributed in this habitat but not commonly encountered. Lobophytum spp. can be found occasionally, and the clownfish anemone Heteractis magnifica is present, but rare.

The commercial topshell Trochus niloticus occupies limestone pavement on the ocean terrace, where its population densities vary from occasional to abundant. The related, but smaller trochid, Tectus pyramis may also be encountered in this habitat. The nudibranch Phyllidia sp. is present on the fore reef slope, but it is rare.

Giant clams are the only conspicuous epibenthic bivalves of the ocean terrace. Tridacna maxima ranges from occasional to rare, and Tridacna squamosa is rare.

The large hermit crab Dardanus megistos can be found in this zone. One individual was observed inhabiting a shell of Trochus niloticus.

Echinoderms constitute the predominant invertebrate phylum of the ocean terrace. The ophiuroid Ophiomastix cf. annulosa, whose arms protrude from beneath plate-like colonies of corals, is the most abundant species on the fore reef slope. The asteroid Linckia multifora is present in densities ranging from common to occasional. Echinoids, including Echinometra mathaei and Heterocentrotus mammillatus, may be encountered in grooves and recesses on the reef slope. The crown-of-thorns seastar Acanthaster planci is scattered on the ocean terrace, where it was observed feeding on corals.

Section 2

## FISHES

### Fringing Reef

**Mangrove Forest (Malil)**

As mentioned in the Flora section, mangrove forests are located primarily on the leeward side of Maap Island. A narrow belt of mangrove forest fringes the inner embayment into Munguuy Bay and between the islands of Maap and Tamil-Gagil along the Yunearawey Channel. YCRI stations in Section 2 did not include mangroves. It is likely that mangroves along this stretch of coastline also serve as a habitat for larval and juvenile fishes. Additionally during high tides, larger adult fish species migrate close to shore. In fact while transiting between stations through the Yinbinaew Channel, several small black-tip sharks (*bako*) were observed to be actively foraging along the margin of the mangrove.

**Reef Flat**

Closest to shore, the seagrass beds serve as a haven for a variety of fish species. Fish diversity is low ranging from 12-15 families with the families Chaetodontidae, Acanthuridae and Pomacentridae being most numerous. Smaller food fishes observed included juvenile parrot fishes (Scarus spp.), goat fishes (Parupeneus multifasciatus), and an emperor fish (Lethrinus harak). Although only one species of rabbit fish was observed (Siganus spinus), it's likely that other species are also present.

**Enclosed Lagoon Holes (Makef)**

Visual observations of the fish populations within Laeneachoqol Hole recorded 20 highly diverse families representing a total of 82 fish species. The most diverse families are wrasses (Labridae), butterfly fishes (Chaetodontidae), and damsel fishes (Pomacentridae). The fish community represented a balanced food chain featuring algivorous, planktivorous, omnivorous, and carnivorous species.

The lagoon hole features several habitat types. The majority of fish hovered closely to the hard coral reef structure. These species included wrasses (Halichoeres trimaculatus, Thalassoma amblycephalum, T. hardwickii), cardinal fish (Apogon leptacanthus, Cheilodipterus quinquelineatus), territorial damselfishes (Stegastes nigricans, Amblyglyphidodon curacao). Schools of the blue-green chromis damselfish (Chromis viridis) occur in large aggregations around branching

Acropora thickets as do Dascyllus aruanus and D. reticulatus. The honey-comb grouper (Epinephelus merra) darts between coral heads while schools of juvenile parrot fishes (Scarus spp.) migrate throughout the coral reef complex. Larger fishes appear singularly such as the grouper Cephalopholis urodeta, while several species seem to congregate in small groups. These fishes include, but are not limited to surgeon fishes (Ctenochaetus binotatus, Acanthurus blochii), and emperor breams such as Gnathodentex aureolineatus and Monotaxis grandoculis, which school above the sand. A solitary yellow trumpet fish (Aulostomus chinensis) hovered in the water column. Several schools of medium-sized rabbit fishes (Siganus puellus, S. virgatus) were also observed in the reef hole.

### Inner Miil Embayment

The number of fish families located within the inner Miil embayment decreases to twelve. This decreased diversity parallels the simplicity of the reef complex and lack of suitable habitats for additional species. Cryptic gobies (Gobiidae), however, are ubiquitous on the adjacent shallow reef flat bordering the channel walls. Small wrasses (Labridae), surgeon fishes (Acanthuridae), and damsel fishes (Pomacentridae) are most abundant and decrease in diversity, respectively. Running along the channel wall are small groups of monocle breams (Scolopsis spp.) and parrot fishes (Scarus dimidiatus, S. sordidus, S. globiceps). Darting among channel wall crevices are butterfly fishes (Chaetodon auriga, C. ephippium) and surgeon fishes (Acanthurus blochii, Ctenochaetus striatus).

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The lush ocean coral reef structure of Section 2 provides a multitude of habitats for the 21 fish families observed during the YCRI survey (YCRI 5,6). Snappers are most abundant on the ocean terrace with Lutjanus gibbus and schools of L. kasmira being abundant, and the snappers Aphareus furca, Lutjanus bohar and Macolor niger occasionally occurring. Several species hover in the water column and include emperor breams (Monotaxis grandoculis, Lethrinus elongatus). Larger parrot fishes (Scarus gibbus, S. niger, S. oviceps, S. schlegeli, S. sordidus) randomly occur in small groups while traversing the reef. Likewise, surgeon fishes schooled along the reef terrace with Acanthurus xanthopterus being most abundant and A.

pyroferus and Ctenochaetus striatus occurring commonly. A total of 12 surgeon fish species were encountered, but wrasses (Labridae) continue to exhibit the most diverse species assemblage (18 species) on the ocean reef. Several cleaner wrasse stations (Labroides dimidiatus) graced the reef front near larger coral mounds and pinnacles. Once again, groups of the pyramid butterfly fish (Hemitaurichthys polylepis) typically featuring between 20 and 30 individuals, schooled along the lush coral frontier. A fleet of fusiliers (Pterocaesio tile) swam through the survey station several times before departing the area (YCRI Station 6). Underneath a coral ledge a group of black bronze sweepers (Pempheris oualensis) was observed. Small groups of the dash-and-dot goat fish (Parupeneus barberinus) foraged actively along the reef.

## OTHER MARINE VERTEBRATES

During the YCRI field survey, no green sea turtles were observed on either the reef flat or ocean reef. Local fisherman, however, described all seagrass pastures as potential turtle feeding grounds.

Section 2

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

In contrast to Rumung, Maap has received the most detailed archaeological study to date. Most of this work has been focused in Tooruw and its associated inland serf village of Nluul. Here sites have been located, described and measured [50,51,54,55]. Test excavations have occurred at one site, yielding dates for the surface structures back to the A.D. 1600s-1700s [54]. Additionally, reconnaissance surveys have been done in Maaloon and Bechyal villages [16,57], and a survey for the Maap powerline covered a portion of Malawaay village [21]. These studies show that the sandy coastal flats of Bechyal and Tooruw have ruins of faeluw along the shore and have the rest of the village sites just behind the faeluw. In Maaloon, the village's sites are located up the valley floors, with the exception of a sea wall at the front of the valley and a faeluw built on an artificial foundation just offshore. The faeluw is in the mangrove-cloaked embayment which Maaloon fronts.

An important consideration for coastal resource management is that oral histories indicate that the inland serf villagers had restricted use-rights to marine reef areas and to types of fishing techniques [52-53]. This means that the historic sites found in the offshore reef may not always be affiliated with the adjacent village; affiliation of the historic site villagers with inland villagers is also possible.

## RESOURCE USES

Interviews with fishermen from throughout Maap Island provided the following fisheries information for this Section (Appendix F).

### Terrestrial

The northern coastline of Maap Island has been recognized as having the most potential as a tourist destination in Yap. Several prominent features, including natural, cultural, and physical designs, suggest the area of Bechyal village as a prominent candidate site for hotel development. For instance, the best beaches in Yap are located along the shoreline of Maap Island, particularly along the north-northeastern coastline. In addition, the Maap Cultural Center in Bechyal, which features an elaborate and authentically decorated men's house (*faeluw*), is already established as a tourist attraction. The area near Bechyal village already has several visitor's bungalows available for use by tourists. Access to the village is by a dirt road, scheduled to be paved in the next 5 - 10 years, and along a garden pathway. The large enclosed lagoon holes (*Laeneachoqol and Qaniif*), also offer a safe, accessible, and interesting reef for snorkeling and diving activities. The area near a hill called Doeweeliil may also be an attractive site for a hotel and golf course according to Yap State Tourism officials [40]. Hence, the island of Maap, offers many activities for a small scale tourist industry.

### Fringing Reef

#### Mangrove Forest (Malil)

Narrow, discontinuous belts of mangrove border the leeward shorelines whereas no mangrove forests occur on Maap's windward coastline. Land crabs (*galip*) and mangrove crabs (*qamaang*) are found in great numbers in these areas, but according to local informants, are only harvested near the village of Bechyal. Currently, there is no commercial mangrove harvesting in progress, although there is some harvesting done for local buildings.

#### Reef Flat

A wide band of seagrasses extends offshore of both the windward and leeward coasts of Maap. The beds located on Maap's windward side and near Yinbinaew Channel, between Rumung and Maap Islands, are reported as sea turtle

feeding areas, although few have been seen in recent years. On Maap's leeward side, goat fishes (*manguch, mbing, soong*) are caught using scoop nets in the seagrass beds. Other species also caught regularly here are parrot fishes (*oye*), milk fishes (*guuguw, tangir*), and silver fishes (*faakeayaan, liyeq*). They are also caught regularly on Maap's windward side using gill nets, surround nets and fish traps. Other species caught regularly on the reef flat are rabbit fishes, goat fishes and surgeon fishes (*bilaew, machagwog*). Another harvesting technique utilizes gill nets set in the evening, and retrieved the following day.

There are a large number of stone fish traps in this Section. Fish traps are sometime used, although their use has diminished in recent years. The traps on the western side and the southeastern side of Maap are generally unused and unmaintained. Fish traps located in the northeastern side of Maap, however, are still in use.

Two sites were investigated for use as dredge sites for fill material in this Section [105]. One site is Yuneanawey Channel which separates Maap from Gagil-Tamil Island. The narrow channel penetrates a dense mangrove forest which is crossed by the Maap-Tamil-Gagil bridge and has been dredged in the past. Any material dredged during future channel widening operations should be stockpiled on land and/or used as fill for road improvements slated for this area. The second site is in Yinbinaew Channel, between Rumung and Maap Islands, and has never been dredged. Currently, there are plans to widen and deepen the channel to facilitate passage during low tide. Materials removed from this area could be used as fill for road improvements or hotel construction projects on Maap Island. Regardless, the fill should be stockpiled on land in an environmentally sound manner until needed in the future.

**Enclosed Lagoon Holes (Makef)**

All enclosed lagoon holes are considered to have good fisheries according to local fishermen. Located on the windward reef flat adjacent to Goofnuw Channel, are two large lagoon holes, Qaniif and Laeneachoqol, which are excellent fishing grounds. Fish species commonly harvested by spear fishing are surgeon fishes (*bilaew, machagwog*) and bumphead parrot fishes. Similarly, these holes are also turtle capture areas, although fewer turtles have been observed and harvested recently.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

Parrot fishes (*qelbad, qalaabal, malngoed, quchwaq, gamaygul*) are harvested on the seaward reef flat and on the fore reef of the ocean terrace. Rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*) and goat fishes (*manguch, mbing, soong*) are also caught in this area among the isolated coral patch reefs. All of these fish are harvested by using a gill net, surround net, or by spear fishing.

**Miil and Goofnuw Channels (Dubchol)**

The deep channel slopes and adjacent reef flat margin provide extensive habitats for several fish species. Along the edge of Miil channel, rabbit fish and goat fish are caught while parrot fish and wrasses (*numean)* are found at the mouth of Goofnuw Channel. Typically, these fish are harvested primarily by the use of gill nets, spearfishing, and to a lesser extent, handlines.

## Ocean Reef Slope (Waru'e naa')

**Ocean Slope**

Seaward of the wave-swept reef edge, fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*machagwog, maath, bilaew)*, rabbit fishes (*dayit, garmiy, buywod, darruy, limreq)*, and goat fishes (*manguch, mbing, soong*). Surround nets, throw nets and spear fishing are the preferred fishing method, with groupers (*smaak'uw, k'uw)* being caught with a handline. Snappers (*gooychaaf*) are caught on a handline at the reef edge. Barracuda (*maal*) and rainbow runner (*thilbuw, foofow*) are both caught by trolling along the ocean slope. Other species also caught trolling, but farther offshore are tuna (*taguw*), dog-tooth tuna (*yasul*), wahoo (*malchath*), and dolphin fishes (*dabaar*). Topshells or Trochus (*yogyog*) are found along the seaward reef's margin as are lobsters (*qaraangoey*) and octopi (*k'aay*). Some harvesting of Trochus (*yogyog*) is being done for subsistence food needs.

## WATER QUALITY

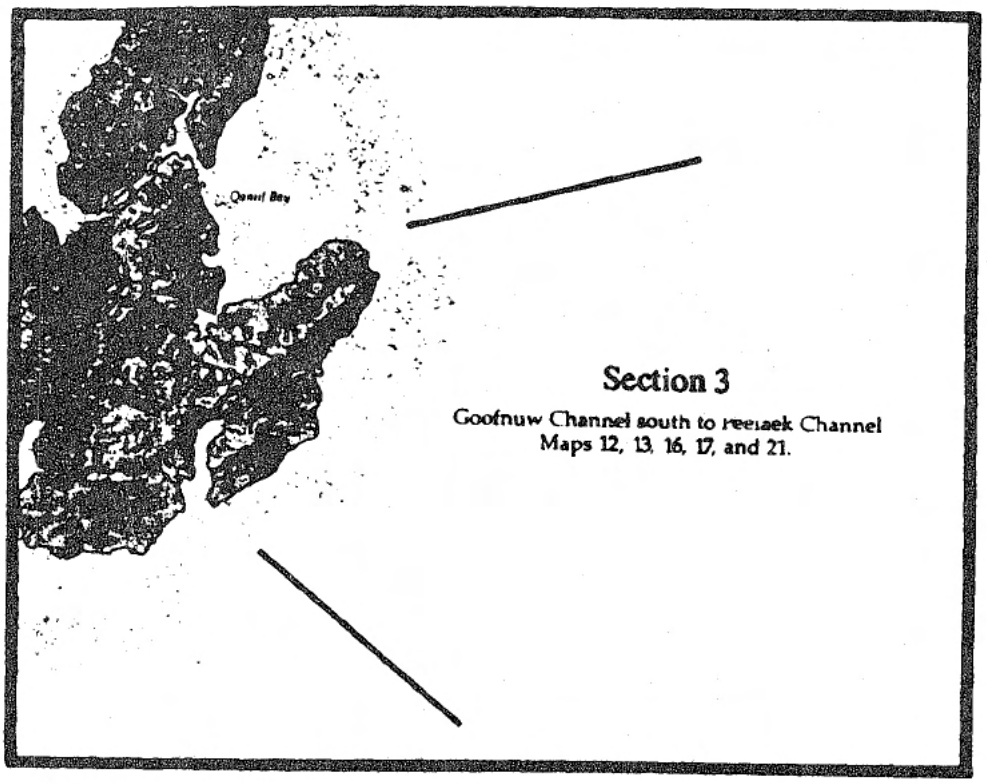
The waters adjacent to Maap Island are classified predominantly as "AA" with the exception of the beach shoreline at Dilmeet island and to the south. This area is classified A. Point sources are absent with non-point sources being fairly scarce as well. Likewise with the other regions, over-water toilets and small discharges from boats predominate. Runoff from rain storms also contributes to erosional problems.

## SECTION 3: GAGIL MUNICIPALITY

### GENERAL DESCRIPTION

This eastern side of Tamil-Gagil island comprises most of Gagil Municipality which is bordered by Goofnuw Channel to the north and Peelaek Channel to the south (Figure 7). Most Yapese reside in windward coastal villages situated along an alternately wide and narrow plain. The resident population is roughly 616 [116]. Traditionally, the district of Gagil has exercised political and religious hegemony over the Yap Outer Islands.

FIGURE 7. A MAP OF SECTION 3 WHICH INCLUDES ONLY GAGIL MUNICIPALITY.



Section 3

## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

Section 3 comprises the north and northeastern side of Gagil-Tamil island which comprises the Municipality of Gagil and roughly one-half of the island's land area. Gagil-Tamil island is only an island by virtue of the Tagireeng Canal, cut and dredged in 1901 during the German occupation, which separates Gagil-Tamil from the island of Yap. The island is composed of two physiographic regions with the eastern ridge comprising all of Section 3 which is bounded by Goofnuw Channel to the north and Peelaek Channel to the south.

The eastern ridge of the island is oriented in a northeasterly/southeasterly direction, extending roughly 4.5 kilometers long (3 miles) and 1.25 kilometers (3/4 mile) wide. Throughout most of its length the ridge achieves altitudes greater than 50 meters (166 feet), with Buchaq having the highest elevation at 81 meters (270 feet). As noted elsewhere on Yap, the slopes steepen toward the coastline where they are nearly vertical cliffs or escarpments 5-10 meters (20-30 feet) high.

Most coastal plains are restricted to the eastern side of the ridge. A fairly continuous plain extends from southern Riikeen to Leebinaew, where it both narrows and widens. Pockets of mangrove forest and fresh water marsh punctuate various segments of the coastline, particularly from Gachpar south to Leebinaew. A narrow sand beach stretches along the coastline north of Wanyaan village.

### Fringing Reef

As with other Sections, the fringing reef of Section 3 encompasses the eastern ridge of Gagil-Tamil island. Its average width is 1.5 to 1.25 kilometers (0.8 miles), although it narrows considerably to less than 50 meters (166 feet) in width along the interior margin of both Goofnuw and Peelaek Channels. North of Gachpar, on the windward reef flat, eight enclosed lagoon holes are distributed along the landward portion of the fringing reef flat. Peelaek Channel comprises the southern boundary of the Section while Goofnuw Channel and its inner embayment delineate the northern boundary of this Section.

### Mangrove Forest (Malil)

The mangrove belt of Section 3 is absent along the exposed eastern coastline, however, patches of mangrove are common along the inner coves of the Goofnuw

embayment and along the headlands of some southern coves. The widest mangrove stand is 300 meters (1000 feet) and borders the steep headlands of Leebinaew. The coastal flats of Gachpar exhibit the largest mangrove stand along the eastern coastline with a width of 150 meters (500 feet). Small offshore mangrove stands occur just seaward of the village of Wanyaan. Along the inner embayment of Goofnuw, isolated forests occur close to Muyuub and Munguuy Bay where Fanyuulaay Creek reaches the shoreline.

**Reef Flat**

The nearshore fringing reef consists of a mixture of calcareous sand, silt, rubble and little or no live coral. During low tides, vast expanses of the nearshore reef flat are completely exposed, particularly the seagrass beds. At the edge of the mangrove forests, a band of sand and silt generally 1-4 meters wide occurs. This band is also present along the remaining nearshore areas of Section 3, but is wider due to the lack of mangroves which trap sediments otherwise transported offshore. Seaward, this zone quickly merges with a mixture of seagrasses in varying densities. Low coral microatolls and mounds are scattered widely in this area, becoming more abundant with increasing distance from shore. Tracts of broken coral rubble become more conspicuous closer to the upper edge or rim of enclosed lagoon holes as does the increased abundance of live massive corals.

The seaward reef flat extends out to the seaward reef edge with substrate composed primarily of sand and eroded reef rock. The water depth ranges between 3-4 meters within the reef moat, but seaward becomes shallower, forming a gentle reef crest near the outer edge. Isolated coral heads and thickets abound in this zone, but are rare seaward. Low microatolls and stout, massive species predominate along the seaward edge of the reef flat. Tracts of rubble and shingle thrown up from the ocean fore reef slope litter portions of this area. These tracts are probably gradually eroded and transported inland by waves and currents.

**Ruunguch Island**

A small mangrove covered island called Ruunguch borders the outer boundary of Tungunbinaew Channel between the islands of Maap and Tamil-Gagil. The uninhabited island faces Qaniif embayment. Extending seaward from the island is a narrow reef flat covered with seagrass beds that merge with a coral

microatoll zone. This zone marks the transition boundary between the shallow reef flat and the deeper Qaniif embayment.

**Enclosed Reef Holes (Makef)**

Eight enclosed reef holes occur on the windward reef flat of Section 3. Compared to Laeneachoqol Hole located in Section 2, these holes are relatively small and uniform in size, the largest being 800 meters (2666 feet) in diameter and the smallest being 100 meters (333 feet) in diameter. YCRI Stations 7a,7b, and 8b document the flora and fauna of three enclosed lagoon holes: Thaaw, Feadamach, and Kefnigaaq.

The landward side of these reef holes are rimmed with lush live coral development with 75 percent coverage on the adjacent hard substrates. Conversely, the seaward rims are virtually devoid of live coral and consist predominately of sand deposits being transported over a hard substrate leading down into a talus chute into the reef hole. The narrow reef flat path, separating Thaaw and Feadamach holes, however, is completely carpeted with lobate and stout corymbose coral species with the exception of a narrow gap in the reef which funnels water currents between the adjacent holes.

Coral coverage on the slope averaged 50-60 percent overall and up to 80 percent on hard substrates. Coral abundance is high although the species diversity ranged from low to moderate. Several massive monospecific heads of columnar and encrusting Psammocora digitata were perched on the sandy lagoon bottom. Elsewhere, large thickets of staghorn corals graced the slope with massive coral pinnacles towering to within 1-2 meters (3-6 feet) of the lagoon margin. Table, encrusting, and foliaceous corals covered much of this inner or landward lagoon slope. The seaward slope, as in other windward lagoon holes, consisted of a sand talus slope to the lagoon floor (10 meters).

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

The outer reef flat is seaward of the lagoon holes and embayments where present or is the outer half of the reef flat. Its margin is a veneer of low to moderate coral coverage of microatolls and low, branching corals over a reef rock pavement. Patches of coral rubble and sand are interspersed. Closer to the outer edge of the reef flat (reef crest), the reef flat is shallower and composed primarily of

solid reef rock layered with rubble and algae, which is frequently exposed during low tides. Small current rills etch the hard pavement which develop into very narrow surge channels (1 meter in width or less) at depths of 1-4 meters (3-13 feet) offshore.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The ocean terrace of Section 3 has similar geomorphological features observed in Section 2 (YCRI Stations 7,8). Dense coral coverage with high species diversity characterizes the entire windward ocean slope. The shallower depths (3-5 meters) include hard substrate patches veneered with massive and stout columnar species which blend into a subtle system of wide ridges and valleys sloping downward. At roughly 16 meters (50 feet), these coalesce into an irregular terrace with moderate relief (1-2 meters or 3-6 feet) including foliaceous and branching coral species. No sand patches are evident.

### Reef Pass (Dubchol)

The only ocean reef pass in Section 3 are Peelaek and Goofnuw Channels and their adjacent embayment which includes YCRI Station 6. Stout microatolls and hard current and wave resistant reef rock pavement, fortify the margin of both channels. The narrow channel entrance of Peelaek shoals landward to about 5 meters (15 feet) before terminating as the steep, vertical walls of the inner embayment. The entrance to Goofnuw, however, is extremely wide (1500 meters or 4500 feet) and sometimes difficult to enter because of confused seas. Little coral colonizes these outside walls other than encrusting forms which veneer the wall leading into the embayment. Lush coral coverage was observed in several of the more protected, backwater areas of the channel.

Section 3

## FLORA

### Fringing Reef

**Mangrove Forest (Malil)**

The mangrove belt of Section 3 is undeveloped along the exposed eastern coastline, however, patches of mangrove are common along the inner coves of the Goofnuw embayment and along the headlands of some southern coves. The widest mangrove stand is 300 meters (990 feet) and borders the steep headlands of Leebineaw. The coastal flats of Gachpar exhibit the largest mangrove stand along the eastern coastline with a width of 150 meters (495 feet). Small offshore mangrove stands occur just seaward of the village of Wanyann. Along the inner embayment of Goofnuw, isolated forests occur close to Muyuub and Munguuy bay where Fanyuulaay Creek reaches the shoreline.

**Reef Flat**

The seagrass Thalassia hemprichii is common in the shallow (2.5 meter or 8.2 feet) sandy zone with some live coral and soft coral patches. Commonly found on the dead portions of corals in this zone are the red algae Gelidiopsis intricata and Polysiphonia spp.

**Enclosed Lagoon Holes (Makef)**

The crustose coralline alga Neogoniolithon and the blue green alga Microcoleus lyngbyaceus were common on the reef flat. On the lagoon hole slope (down to 9 meters), the red algae Gelidiopsis intricata and Polysiphonia spp. were common on the dead Acropora branches. Other common, but more cryptically located species are Caulerpa racemosa and Hypnea pannosa. Other algae on the lagoon slope that are present, but rare, are the green algae Caulerpa taxifolia, and Valonia ventricosa and the brown alga Turbinaria ornata.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

On the seaward margin of the reef, the brown alga Turbinaria ornata is growing in the shallow depressions on the reef pavement.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

On the shallow (depth less than 5 meters or 16 feet) part of the ocean facing slope, crustose coralline algae are common on the reef pavement and on the Acropora shingle. Elsewhere, algae becomes an inconspicuous component of the coral reef.

Section 3

## CORALS

### Fringing Reef

**Reef Flat**

The inner reef flat along the shoreline of Gagil Island is dominated by dense seagrass beds with little or no coral cover. Further out where the reef flat depth varies, scattered Porites lutea microatolls may be found, resulting in highly variable coverage from 0 to 30 percent. In some locations, other corals such as Pocillopora damicornis and small heads of Pavona are present. Coral coverage can be very high with cropped ramose Acropora species being dominant along the bends of the embayment and at the edge of the reef holes in protected situations. At locations where the fringing reef flat extends directly to the ocean, coral cover is moderately low. Extensive sand flats blanket these areas typically with isolated coral patches of varying dimensions.

**Enclosed Lagoon Holes (Makef)**

An interconnected network of live coral fringes the upper surfaces of most lagoon holes although it is frequently absent on the seaward side of windward lagoon holes (YCRI Station 7a). Coral abundance is high averaging 50 percent coverage overall and 75 percent on hard surfaces. Low to moderate coral diversity characterizes both the reef margin and slope fauna with Acropora being dominant. Stout ramose Acropora and Porites microatolls form a densely packed coral assemblage that rings each hole's margin. Other common corals include the delicately branched Pocillopora damicornis, Seriatopora, Pavona cactus and mounds of Favites. In 2-4 meter (6-13 feet) depths, extensive monospecific stands of Acropora formosa are conspicuous features. Large tracts of Porites cylindrica and large expanses of the foliaceous coral Merulina ampliata and the columnar coral Psammocora digitata add relief to the slope's composition. Other common corals include fire corals (Millepora), mushroom corals (Fungia), and heads of Porites (S.) rus, Hydnophora, Favia, and Goniopora. Below depths of 10 meters (33 feet), sand dominates the floor substrate of the hole, and coral cover falls between 0 to 20 percent.

**Seaward Reef Flat (Lan e rayem \ Daken e naa')**

The reef flat margin is made up of a solid framework with 10 to 30 percent

coral cover, mostly in the form of Porites microatolls and small massive coral colonies. The landward reef flat supports scattered patches of low branching Acropora colonies as well as Porites microatolls. Overall coral cover ranges from 0 to 10 percent. The shallow reef flat pavement at the barrier reef crest supports almost no coral development with small incrusting patches of Montipora or Cyphastrea being present.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

Coral cover and diversity remains high as the ocean terrace gradually descends to deeper depths. The genus Acropora is dominant and features ramose, corymbose, and staghorn forms. Acropora palifera, a columnar branching species, is most abundant with arborescent patches of A. irregularis being locally abundant. Other common Acropora include staghorn species such as A. formosa, and A. acuminata or stout corymbose forms like A. humilis. Less abundant, but intermixed with these are heads of Porites, Millepora (fire coral), the brain corals Favites, Goniastrea, and Favia and others. Coral cover remains between 60 to 80 percent as the terrace gradually slopes deeper.

Section 3

## OTHER INVERTEBRATES

### Fringing Reef

#### Reef Flat

Reef flats of Gagil support an abundant array of sponges. A black sponge and a brown sponge are abundant in association with reef rocks scattered on the outer reef flat. The branching sponge cf. Clathria cervicornis is abundant in the seagrass meadow. A testillid sponge with large, protruding spicules is scattered among coral colonies at the seaward boundary of the reef flat.

Soft corals of the genera Sinularia and Lobophytum are scattered in this zone. They may be encountered on reef rock of the outer reef flat. The benthic jellyfish Cassiopea medusa is common on the soft substrate of the seagrass meadow.

Intertidal rocks along the shoreline support populations of the littoral snails Nerita plicata and Fissilabia decollata. The common spider conch Lambis lambis may be encountered in the seagrass meadow. Numerous shells of dead Strombus urceus litter the substrate among the seagrasses. The coral-boring scallop Pedum spondyloideum can be bound embedded in massive colonies of Porites corals on the outer reef flat, and the black-lipped pearl oyster Pinctada margaritifera is scattered among reef rocks.

The predominant macroinvertebrate of the reef flat is the asteroid Protoreaster nodosus. These seastars are abundant among the seagrasses. The sea cucumber Holothuria atra is also abundant in the seagrass meadow. Soft substrates on the outer reef flat support scattered individuals of Bohadschia marmorata. The echinoid Echinometra mathaei and the sea cucumber Holothuria edulis occur on the outer reef flat, but they are rare.

#### Enclosed Lagoon Holes (Makef)

Lagoon holes of Gagil support a diverse and abundant macrobenthos fauna. The orange sponge Stylotella agminata is the most widespread poriferan. A black sponge and a brown sponge are scattered on the reef slope of the lagoon holes.

The predominant forms of macrobenthos are cnidarians other than scleractinian corals. The stoloniferan Clavularia sp. is ubiquitous on the reef slope, from the upper margin to the base of the slope, as is the yellow soft coral Sympodium sp. The upper margin of the slope supports an abundant population of the soft corals Asterospicularia randalli and Stereonephthya spp. Sinularia spp. and

Xenia sp. are commonly observed in this zone. Lobophytum spp. and Litophyton spp. may be occasionally encountered.

Epibenthic polychaetes are present, but not abundant. The feather-duster worm Sabellastarte sanctijosephi is common on reef rock, and the Christmas-treeworm Spirobranchus giganteus may be found on Porites coral colonies.

Gastropods are present, but they do not exhibit high diversity. Dendropoma maxima, a sessile, suspension-feeding snail, is widely distributed, and it reaches its greatest abundance on poritid corals found on the upper reef slope. The tiger cowrie Cypraea tigris may be observed in scattered recesses of the reef slope. The only epibenthic bivalve encountered was the black-lipped pearl oyster Pinctada margaritifera.

Spiny lobsters of the genus Panulirus can be found in the enclosed lagoon holes. They are usually associated with concavities beneath massive coral outcrops.

Echinoderms of the lagoon holes are diverse, but they are not very abundant. The upper reef slope is sparsely occupied by the asteroids Culcita novaeguineae and Linckia laevigata and the sea cucumbers Holothuria atra and Stichopus chloronotus. Other echinoderms that are present, but rare on the reef slope include the seastars Acanthaster planci and Fromia sp. and the sea cucumber Holothuria nobilis.

The sea cucumber Bohadschia argus inhabits the sandy floor of the enclosed lagoon holes, where it ranges in abundance from common to rare. Callianassid mounds are the predominant feature of the lagoon floor.

### Ocean Reef Slope (Waru'e naa')

The fore reef slope provides habitat for several sponge species. Dysidea herbacea is abundant on upper surfaces of reef rock. The orange sponge Styloterra agminata is likewise abundant in small channels and grooves on the slope. A black sponge and a tan finger sponge are common on the upper slope, and testillid sp. 1 can be observed in recesses under coral heads.

Octocorals constitute a diverse faunal element on the fore reef slope. The soft coral Xenia sp. is the most widely distributed species in this habitat, but Sympodium coeruleum attains greater densities in localized areas. Other soft corals that may be encountered include Bellonella sp., Cladiella sp., Lobophytum spp., Sarcophyton spp., Sinularia spp., and Litophyton spp.

Other cnidarian macroinvertebrates on the fore reef slope include the stoloniferan Clavularia sp., which is present in considerable abundance in localized areas. A plexaurid gorgonian was encountered on the reef slope near the pass to Goofnuw Channel, and Palythoa sp., an encrusting zoanthiniarian, may be found here also.

Epibenthic polychaete worms occupy the fore reef slope. The Christmas-treeworm Spirobranchus giganteus is common in massive Porites coral colonies. The feather-duster worm may be observed protruding from its parchment tube, which is attached to reef rocks or coral heads.

Molluscs are neither abundant nor diverse on the fore reef slope of Gagil. The commercial topshell Trochus niloticus is scattered on limestone pavement of the ocean terrace. The sessile, tube-building snail Dendropoma maxima is abundant on massive coral colonies. The giant clam Tridacna maxima is present on the upper reaches of the fore reef slope.

The hermit crab Dardanus megistos may be found on the ocean terrace. Large individuals occupied shells of Trochus niloticus measuring 8-9 cm in diameter. Echinoderms observed on the fore reef slope of Gagil are representative of this habitat in Yap in general. Scattered individuals of the seastars Linckia multifora and Acanthaster planci are present. Spines of Echinostrephus cf. aciculatus protrude from the urchins' burrows in the walls of small channels of the reef slope. The sea cucumber Bohadschia argus is present, but rare.

Ascidians are represented on the fore reef slope by Didemnum molle. These zoochlorellae-associated tunicates occupy dead coral and reef rock substrates.

## FISHES

### Fringing Reef

**Mangrove Forest (Malil)**

Discontinuous mangrove forest patches span the length of Gagil along the inner reef flat margin. A tangled network of mangrove prop roots provides abundant cover for juvenile fishes as well as some adults. Likewise, several species of cardinal fishes (Apogonidae), snappers (Lutjanidae) and mojarras (Gerreidae) are commonly observed along the outer mangrove edges.

**Reef Flat**

The inner reef flat areas, particularly along the seagrass beds, are lacking in vertical relief and live coral development. Most of the fishes observed are juveniles or smaller adults. The most commonly observed fish is an unidentified goby (Gobiidae) which cohabits a hole in the muddy substrate with a cassionalid shrimp. Other fishes periodically seen are surgeon fishes (Acanthuridae), rabbit fishes (Siganidae), damsel fishes (Pomacentridae), wrasses (Labridae) and some goat fishes (Mullidae). Larger, predator species such as sharks periodically forage through this area during high tides.

Seaward and extending out to the reef flat margin, the distribution of fishes is variable and seems to be dependent upon the relative percentage of live coral coverage. Extensive sand flats are virtually depauperate of fishes. Isolated, live coral thickets and massive heads intermixed with soft coral patches, however, attract a fairly diverse fish assemblage. For instance, at YCRI Station 7a, fourteen families were observed representing 62 different fish species. Similarly the most diverse fish families continue to be wrasses (Labridae) and damsel fishes (Pomacentridae).

The surgeon fish Ctenochaetus binotatus, the damsel fish Dascyllus aruanus, and juvenile parrot fishes (Scarus spp.) are the most commonly observed species. Small schools of Acanthurus triostegus (surgeon fish), Gnathodentex aurolineatus (emperor bream), and Scarus oviceps (parrot fish) swim among these coral formations while the honey-comb grouper (Epinephelus merra) dashes between coral heads. Several species of goat fishes (Mulloidies flavolineatus, Parupeneus barberinus, P. multifasciatus) forage along the sandy bottom adjacent to these coral formations.

Section 3

**Enclosed Lagoon Holes (Makef)**

Fish populations associated with the lagoon holes of this section (YCRI Station 8a & 8b) are highly diverse with 93 species being observed from 23 families. High coral coverage provides extensive underhangs and a matrix of habitats for a variety of fishes. Wrasses (Labridae), damsel fishes (Pomacentridae), and butterfly fishes (Chaetodontidae) continue to represent the most diverse families, having 18, 15, and 14 different species respectively. An interesting assemblage of preferred eating species are also found here. These fishes include surgeon fishes (Acanthurus nigroris, A. nigrofuscus, A. xanthopterus, A. triostegus, and Naso lituratus), rabbit fishes (Siganus lineatus, S. argenteus), parrot fishes (Scarus oviceps, S. sordidus, S. ghobban) and snappers (Lutjanus fulvus, L. gibbus). With regularity squirrel fishes (Holocentridae) were observed hovering underneath coral overhangs. Moving throughout the boundary of the lagoon holes are goat fishes (Mulloides flavolineatus), monocle bream (Scolopsis lineatus), and emperor breams (Gnathodentex aureolineatus, Monotaxis grandoculis). Clinging to coral heads are pipe fish (Corythoichthys intestinalis).

**Ocean Reef Slope (Waru'e naa')**

**Ocean Slope**

The diversity of the fish community increases dramatically again on the seaward reef terrace which slopes gradually to deeper waters. A total of 24 families were observed representing 70 different fish species (YCRI Station 7, 8). The most diverse assemblage of butterfly fish species occurred in this section, followed by wrasses and surgeon fishes, both having 15 species reported. Parrot fishes (Scarus spp.), primarily large adults, are common throughout the seaward terrace with 11 different species observed. Throughout this zone, snappers (Lutjanus gibbus, Macolor niger), sweetlips (Plectorhinchus gibbosus), fusiliers (Caesio caerulaureas), emperors (Gnathodentex aureolineatus) and surgeon fishes (Acanthurus nigrorus, Ctenochaetus striatus, Naso lituratus) are common. Residing close to the coral substrate are several species of butterfly fishes with the pyramid butterfly (Hemitaurichthys polylepis) continuing to be most abundant. Territorial damsel fishes such as Chromis viridis, C. margaritifer and Plectroglyphidodon dickii are also commonly encountered close to the coral substrate. A pair of the yellow rabbit fish (Siganus vulpinus) migrated through the area as did several schools of rudder

fish (Kyphosus cinerascens, K. vaigiensis). A large adult bat fish (Platax orbicularis) was seen at YCRI station 7, one of only two observations throughout the entire YCRI ocean reef surveys.

## OTHER MARINE VERTEBRATES

During the YCRI field survey, no green sea turtles were observed on either the reef flat or ocean reef. Local fisherman, however, described all seagrass pastures as potential turtle feeding grounds. Fishermen indicated that turtles were frequently seen in the enclosed lagoon holes off Gagil and Tamil municipalities. An unidentified pod of porpoise was also observed offshore near the vicinity of YCRI Stations 6 and 7.

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

In the mid-1800s, the period of initial intensive European contact, Gagil was the center of political power for northern Yap and the critical link for all Yap to the outer islands to the east. Gachpar village -- particularly its two subsections, Ariap and Tholang -- was the political focal point. Archaeological work to date in Gagil has been limited largely to Gachpar village -- with a reconnaissance survey of its housing area [16,17] and archaeological testing of two sites [58-59]. Dates are limited and indicate that the surface sites date back at least to the A.D. 1400s-1700s [59]. A striking coastal settlement pattern feature of Gachpar is its string of five faeluw which guard its shoreline. Three were built on offshore foundations; the others project from the sandy shore.

Other than a reconnaissance survey of the village area of Binaew (an inland serf village) [17,18], part of the savanna area of Makiy [21], and part of the village area of Ruuq [58,59], no other villages of Gagil have been surveyed. However, a social anthropological study in Wanyaan village, a high ranking village next to Gachpar, provides a good reconnaissance Maap of the housing area -- again showing a defensive line of faeluw [75].

No archaeological survey of fishtraps or agricultural areas have been undertaken in Gagil -- yet these intensive subsistence sites must have played a role in the rise to power of this area and in its continued place of power. Also, information on past reef resource exploitation is limited since few collections of faunal remains have yet to be excavated. There are some interesting findings from one of the Gachpar site excavations, however. At the Garingmog site, Cerithium sp. dominates the mollusk remains in all excavated layers. This is a mangrove species, suggesting mangroves were more widespread in the A.D. 1700s at Gachpar [59].

**Section 3**

## RESOURCE USES

Information for this section was primarily obtained from interviews with fishermen from Gagil and Maap municipalities (Appendix F).

### Terrestrial

Wanyaan village in Gagil Municipality also has one of the nicest beaches in this Section of Yap Proper [26]. Additionally, adjacent to Wanyaan and Gachpar are several enclosed lagoon holes considered to be good recreational snorkeling and diving areas by the Division of Tourism and Industries [126]. With support from the local residents, this site could be developed as a public beach park for residents and visitors. Furthermore, if the roads to this area were improved, this would greatly enhance the use of this area by visitors. Currently, however, there are no scheduled improvements being considered for this road.

### Fringing Reef

#### Mangrove Forest (Malil)

Large mangrove forests in southern portions and smaller forests along eastern and northern shorelines are used mainly for local building material. Some potential for small scale logging for charcoal may exist, but the small size of the forests makes large scale commercial logging ventures highly unlikely. Commercial logging, however, is not being considered at this time.

#### Inner Embayment

Silver fishes and flagtails (*faakeayaan, liyeq, qachwoq, qanger)* are found in large quantities in nearshore estuaries. These fishes are currently being harvested by surround nets for consumption. A resource assessment could be implemented to determine if there is a sufficient baitfish population to support, in part, proposed future commercial tuna fishing activities in Yap.

#### Reef Flat

As in other reef flat areas, the fisheries are considered to be highly productive and abundant. Mullet (*quloch, galaed*) school along the seagrass beds near the villages of Thool and Qabyaang. Generally, they are harvested by gill nets and surround nets. Fishermen report harvesting many fish species intermixed

among the complex coral patches and thickets. These species include surgeon fishes (*quum, machagwog, bilaew, maath*), parrot fishes (*qelbad, qalaabal, malngoed*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq)*, goat fishes (*manguch, mbing, soong)*, emperor breams (*wul, qoeyeq, gadgad)*, and wrasses (*numean)*. These fish are also caught within Goofnuw and Peelack Channels. Jacks (*ngool, m'uul, qelqel)* are taken near coral heads throughout this Section by spear fishing or handline. Stickfish (*buuy*), rudder fishes (*guumiy*) and milk fishes (*guuguw*) are also plentiful throughout the reef flat and harvested using gill nets or spear fishing. Snappers (*gooychaaf*) are caught throughout the reef flat with a spear or net. Similarly, turtles are captured infrequently and are rarely seen now. Topshells or Trochus (*yogyog*) are found abundantly along the reefs edge throughout the area. Trochus are harvested commercially by islanders through a regulated system setforth by the Yap State Legislature and administered by the MRMD.

Stone fish traps (*qech*) and non-stone fish trap sites (*yanup, saagel*) are found throughout this Section. In recent years, very few fishermen have used any of these fish traps. Some fishermen, however, have used stone traps to direct reef fishes into their gill nets.

A potential dredge site for fill material is being considered for an area near Wanyaan in eastern Gagil out to Thaaw and Feadamach lagoon holes [123]. This was not one of the sites evaluated in a consultants' report prepared on existing and potential dredge sites [105]. Fill material would be used for future road improvements in this region.

**Enclosed Lagoon Holes (Makef)**

All enclosed lagoon holes are considered to have good fisheries according to local fishermen. Several fish species are caught regularly such as parrot fishes. These fishes are normally harvested using gill nets and spearfishing. Angel fishes (*qeer, buloch*) are caught by spear fishing along the shallow portions of these holes.

**Inner Embayment and Channels**

Surgeon fishes (*quum, machagwog, bilaew, maath*), parrot fishes (*qelbad, qalaabal, malngoed)*, rabbit fishes (*dayit, garmiy, buywod, darruy, limreq)*, goat fishes (*manguch, mbing, soong)*, emperors (*wul, qoeyeq, gadgad)*, and wrasses (*numean)* are found along the reef flat from the reef's edge to the nearshore, and within the

**Section 3**

Goofnuw and Peelaek channels.

## Ocean Reef Slope (Waru'e naa')

### Ocean Slope

The ocean reef fisheries are abundant and diverse. Fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed)*, surgeon fishes (*machagwog, maath, bilaew*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), and goat fishes (*manguch, mbing, soong*). Gill nets, surround nets and spear fishing are the preferred fishing method, with groupers (*smaak'uw, k'uw*) being caught with a handline. Snappers (*gooychaaf*) are caught on a handline at the reef edge. Barracuda (*maal)* and rainbow runner (*thilbuw, foofow*) are both caught by trolling along the ocean slope. Other species also caught trolling, but farther offshore are tuna (*taguw*), dog-tooth tuna (*yasul)*, wahoo (*malchath*), and dolphin fishes (*dabaar*). As in other sections, these species are not fished heavily since a power boat is needed. Flying fish (*goeg*) are caught seasonally, January through March, outside the ocean reef. They are usually caught at night using a lantern to attract them, and a scoop net to net them as they fly by or during the day with a scoop net.

WATER QUALITY

No point sources were observed off Gagil. Non point sources include road repair runoff, small gardens, soil preparation and some area clearing for housing construction [30]. The waters around Section 3 are classified AA except for an area near Wanyaan which are classified A because it may be used for recreational purposes. No violations for any standards were reported for this area [18].

This section has one of the potential dredge sites in Yap, which if used, could create conditions were the standards set for several of the parameters, (especially turbidity, and total suspended solids) may be exceeded. Mitigative measures such as the use of sedimentation nets and other outlined in the Shore Protection Manual of the U.S. Army Corps of Engineers [114] should lessen the impact to the water quality and adjacent marine life. Construction of containment berms around the dredging sites prior to dredging is also effective in preventing damage to adjacent coral reef areas.

## SECTION 4: EASTERN TAMIL, QATLIIROW EMBAYMENT, TAMIL HARBOR AND EASTERN RUUL

### GENERAL DESCRIPTION

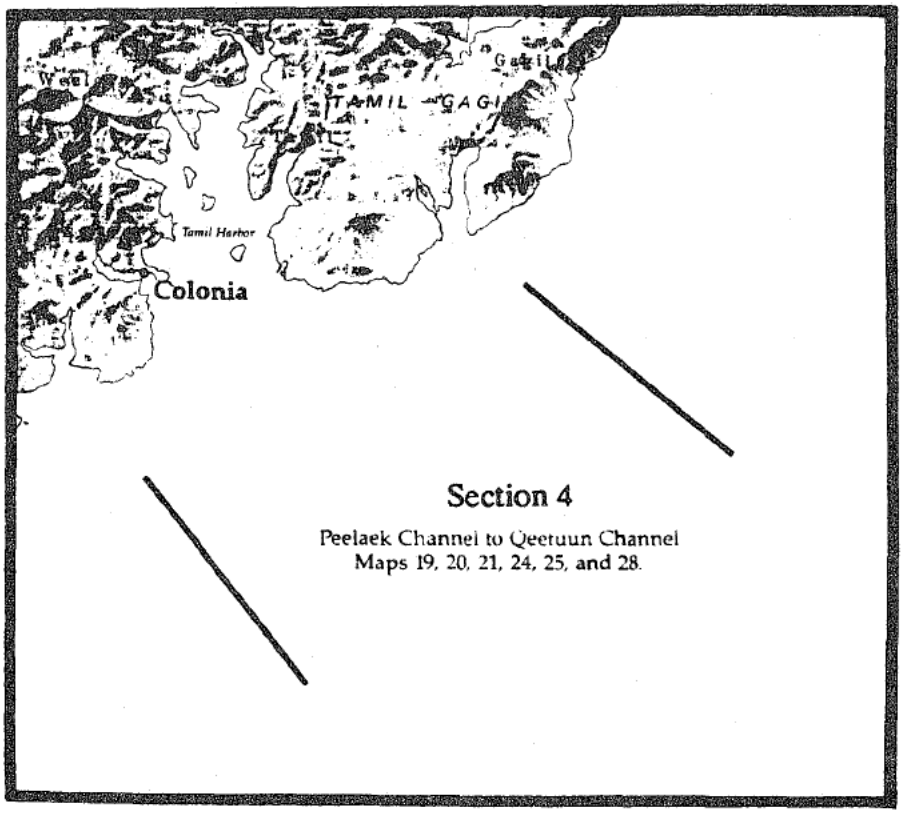
This Section is bounded by Peelaek Channel to the north and Qeetuun Channel to the south (Figure 8). Also included in this section is the paramount embayment of Tamil, including Tamil Harbor and Chamorro Bay, and Qatliirow Channel. Municipalities bordering these shorelines are Tamil on Gagil-Tamil island and the windward sides of Fanif, Weeloey, and Ruul municipalities on Yap Island. Yap's only urban center, Colonia, is situated along the perimeters of Tamil Harbor and Chamorro Bay with other smaller villages stretching inland and along the coasts. Three unpopulated islands are situated in the embayment: Taraang, Paakeal and Biy Islands. Taraang Island or "O'Keefe's Island" is occasionally used as a picnic spot.

The islands of Yap and Gagil-Tamil were naturally joined by a narrow isthmus and mangrove forest. In 1901, however, the Tagireeng Canal was cut through the isthmus and dredged both north and south to create a passageway for small boats by the German administration. The original canal was about 5.5 meters (18 ft) wide at it narrowest point and about .03 meters (1 foot) deep at its shallowest during low tide and 1.5 meters (5 feet) deep during high tide. During this period, a LCM (Landing Craft, Mechanized) was considered to be the largest boat to pass through the canal at near high tide [65].

Today, however, boat passage is severely restricted by the canal's narrowness and shallow depths. Unsupported and unstabilized canal banks slid and wash into the canal as mud and rocks, creating variable depths throughout the canal. Because there is no systematic maintenance of the canal, shoaling and floating and/or submerged logs create navigational hazards. Hence, boat passage is commonly prohibited during the period of 1.5-2 hours bracketing either side of low tide. Additionally, access to the canal from both the north and south require careful negotiation of a pole-lined channel to avoid mangrove roots and dead coral microatolls, easily capable of damaging a boat's propeller.

Adjacent to Tamil Harbor and Chamorro Bay is Colonia, the Capitol, administrative, and commercial center of Yap State. It was also the administrative seat for both the Japanese and Germans. As with most other Pacific island urban centers, Colonia is the largest population center with 1,414 people representing various ethic groups [116]. Most of these people reside in villages surrounding Colonia, both inland and along the coastlines. As Yap transgresses from a purely subsistence economy, more villagers are

FIGURE 8. A MAP OF SECTION 4 WHICH INCLUDES THE AREAS OF EASTERN TAMIL, QATLIIRTOW EMBAYMENT, TAMIL HARBOR, AND EASTERN RUUL.




commuting daily to Colonia for jobs and errands; many, however, have built second homes near Colonia. Typically, Yapese with second homes will return to their villages on the weekend to tend gardens, go fishing, and participate in village activities. Hence, there is a marked tendency for the Colonia population to swell during the week, and for the town to be virtually deserted during the weekends. Other ethnic groups, such as the Yap Outer Islanders or the Palauans, reside in nearby Colonia communities like Maedriich or Worwoq villages.

Much of Colonia borders a small inlet called Chamorro Bay which is crossed by a causeway and bridge in two locations. Tidal water exchange occurs through the eastern

bridge's ten meter (30 ft) wide opening with Tamil Harbor waters. At low tide, much of the inner inlet's floor is exposed. A stone rip rap revetment wall stabilizes most of the inner banks of the Bay to protect the adjacent paved road. Another small bridge at the western end of the inlet (about 6 meters wide (20 feet)), on the road to Magachaguill, crosses the inlet at Mulroq village and leads into a mangrove forest. A landfilled area designated as a Public Works equipment baseyard is located on the northern side of the Bay. Additionally, the Bay also serves as a safe anchorage for about 30 private small boats.

Another small causeway and bridge lies just north of Colonia toward Keeng. The bridge connects Colonia with Nimaar village by crossing a shallow mangrove lined inlet.

Tamil Harbor is a natural harbor of irregular shape and is the principal port of Yap State. The commercial wharf, built in 1980, is 1370 meters (450 feet) long, with a dredged depth of 11.3 meters (37 feet). All cargo ships unload supplies and onload export products such as copra. Additionally, the harbor is the home port of the Yap State interisland support ship, the Micro Spirit.

## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

Section 4 comprises a large area bordered by Thool village located along the interior of Peelack Channel and south to Gitaem village located adjacent to the northern finger of Gabach Channel in the Municipality of Ruul located on Yap Island (YCRI Stations 9, 9a, 9b, 9c, 10, 11). This Section also includes the large embayment of Qatliirow and Tamil Harbor, and north to the Tagireeng Canal (YCRI Stations 10a, 10b, 10c, 10d, 10e, 10f, 10g, 10h, 10j, 10k). Three offshore high islands: Biy, Taraang, and Paakeal, located on the reef flat just north of Tamil Harbor will also be reviewed in this Section.

A central plateau on Gagil-Tamil island is evenly dissected into long rolling hills or moderately steep hills north of Maakiy with steep sided ridges along its western margin adjacent to the inner Qatliirow embayment. Proceeding west from the peninsular extension of Thool, two other peninsular extensions lie adjacent to Tamil Harbor which slope gently southward to flat terraces 7 meters (23 feet) in height. Locally, cliffs are prevalent where mangrove lines the shore; elsewhere, steep banks are typical. About a dozen perennial and intermittent streams flow into this coastal region.

The eastern side of Yap Island bordering this Section consists of a range of high hills and ridges with an average elevation of 130 meters (433 feet). Local land relief varies, but typically consists of steep slopes to cliffs and escarpments 7-10 meters (20-30 feet) high along the shoreline. The hills of northern Yap are bordered by seven peninsular extensions on the eastern coast which are separated by deep reentrants to Tamil Harbor and the inner embayment. Coastal plains are absent on the west coast with the exception of small isolated alluvial flats at the heads of inlets. Numerous streams, some of which are perennial, flow a relatively straight course to the shoreline with no tributaries.

### Fringing Reef

As with other Sections, the fringing reef of Section 4 surrounds the adjacent lands in varying dimensions. The seaward fringing reef has the greatest width ranging from 3 kilometers (1.8 miles) to just under 2 kilometers (1.25 miles). Along Tamil Harbor and the interior of Qatliirow embayment, the reef narrows substantially, averaging 300 meters (1000 feet) in width, but frequently to less than 50 meters (166 feet) along the narrow coastal flats of the western peninsulas. On the northeastern ocean reef flat, eight (8) enclosed lagoon holes are found while only two (2) are found on the southwestern ocean reef flat. Colonia, the primary urban center in Yap, and the major commercial port of

Tamil Harbor, represent paramount features within Qatliirow embayment and Section 4.

**Mangrove Forest (Malil)**

Despite Section 4 having the largest embayment and greatest adjacent land area, mangrove forests are poorly developed in all but a few localities. A narrow mangrove band borders much of the eastern inner Qatliirow embayment as well as small areas on the three offshore islands of Biy, Taraang, and Paakeal. A small stand also occurs at the headlands of Chamorro Bay which fronts the urban center of Colonia. Additionally, the northern portion of the Tagireeng Canal, which opens into the Miil embayment, supports a moderate mangrove forest. Moreover, Section 4's largest and Yap Proper's second largest mangrove forest occurs just south of Peelaek Channel from Maaq village to Dechumur village, spanning 500 meters (1666 feet) inland and roughly 1.3 kilometers (0.8 miles) along the shoreline.

**Reef Flat**

Within Section 4, the reef flat can be divided into three relatively distinct physiographic and geographic units. These areas are: (1) the inner Tamil Harbor and Qatliirow embayment paralleling the eastern and western coastlines; (2) the middle portion of Tamil harbor moving seaward and including the islands of Paakeal, Taraang, and Biy; and (3) the outer reef flat zone comprising the areas of Biy island north to Peelaek Channel and south from Baleabaat to Qeetuun Channel. For a clearer presentation, each of these areas will be discussed separately.

Without question, terrestrial materials including silt are the predominant substrate component of the Tamil Harbor and inner Qatliirow embayment region. A combination of sand, silt and rubble characterize the nearshore substrate with little or no live coral. During low tides, reef flats located within the interior coves of Qatliirow embayment are frequently exposed up to 200 meters from shore. Vast expanses of mud flats laced with silt deposits and mucous sloughing microatolls are prominent in these localities. In Chamorro Bay, however, the old reef flat is 99 percent covered with mud and silt which has a maximum depth of 3 meters (12 feet); live coral coverage is estimated to be less than one percent. Several uncharted enclosed lagoon holes also occur in this region (YCRI Station 10d).

Although silt actively migrates through the middle portion of Tamil Harbor by and between the islands, it is not considered the predominant substrate. From the peninsular

extension of Tooruf Point, a reef flat platform roughly 500 meters wide, supports the islands of Paakeal and Taraang. A belt of silt and sediment circles each island due to the mangrove forest acting as a sediment trap. This 2-4 meter (6-12 feet) wide zone quickly merges with a field of seagrass of varying densities interspersed with sand. In some places, Halimeda sand is most abundant. Between the two islands a shallow, smooth reef rock platform exists in water depths of only 0.5 meters (1.6 feet) at low tide. Widely dispersed coral heads are found on the western side of the reef flat facing Colonia.

A combination of sand, silt, and coral rubble comprises the nearshore area of the outer ocean fringing reef flat with little or no live coral coverage. Similar to other nearshore regions, a band of silt and sediment occurs at the outer edge of the mangrove belt and extends seaward. In the northeastern reef flat, the mangrove forest is slowly enlarging as evidenced by the proliferation of isolated mangrove patches growing offshore (100 meters [300 feet] or less) amongst the seagrass beds. This is particularly noticeable off the men's house (*faeluw*) at Yimuch.

The shallow reef flat platform extends out to the fringing reef edge with substratum composed primarily of eroded reef rock and sand. The outer edges of the reef flat at Qatliirow Channel, to both the north and south, are blanketed with interconnecting coral thickets and monotypic stands of massive and corymbose coral species, particularly Porites and Acropora (3-20 meters [10- 66 feet] in diameter). Tidally influenced water depths control passage of boats through this lush coral assemblage. Coral coverage is as high as 25 percent in the back reef zone.

**Enclosed Lagoon Holes (Makef)**

As mentioned previously, the eastern ocean reef flat has eight enclosed lagoon holes while only two are found on the western ocean reef flat. Similar to other Sections, there is no common shape among all the lagoon holes.

The majority of these lagoon holes continue to exhibit sand and talus slopes on the seaward edge although coral stands are also more prevalent there. A network of coral stands links several of these holes together, particularly on the landward end of Qalqath hole. All lagoon holes located within the inner Qatliirow embayment region exhibit levels of coral development around their margins varying from low to high.

The outer reef flat holes have a similar zonation pattern and abundance and diversity of flora and fauna as previously mentioned for lagoon holes. The biota and physiography of the inner reef flat holes, however, have been modified by intense

terrestrial and water circulation stresses. For example, a small irregularly shaped, mud filled hole varying from 1-6 meters (3-20 feet) in depth (YCRI Station 10d), supports a low to moderate coral knoll population (35 percent coverage) on the bottom, and with low microatolls, frequently dead, fringing the surrounding shallower reef flat.

In the middle reef flat of Qatliirow Channel near Taraang Island, a small, steeply sided lagoon hole with a maximum depth of 18 meters (60 feet) was examined as YCRI Station 10c. The nearly circular hole is completely closed off by dense coral assemblages at low tide with overall coverage surprisingly high (greater than 50 percent cover) for its location in the embayment's interior. Overhanging Porites lutea heads comprised the upper substrate of the reef hole while stabilizing coral growth further downslope. Foliaceous plates and massive species colonize the deeper walls descending to a talus sediment floor.

### Reef Islets

Three small islands are located within the Qatliirow embayment. Paakeal, the most northern island in the harbor, rises 5 meters (15 feet) above sea level. It slopes gently to its mangrove rimmed shoreline. Taraang Island which is commonly referred to as "His Majesty O'Keefe's Island", is located about 175 meters from Paakeal, and also rises to 5 meters in elevation with the northwestern side surrounded by mangrove forests. Dome-shaped Biy Island is the most eastern of the four islands and is completely encircled by mangrove [65]. Donitsch Island, however, which lies just off the tip of Colonia's peninsula, is now connected by a 300 meter (1000 feet) man-made causeway to the main island of Yap.

### Seaward Reef Flat (Lan e rayem \ Daken 'e naa')

Moving seaward from the back reef flat, the outer reef flat margin shows a biota less diverse and abundant as it merges into a flat, wave-inundated platform (YCRI Station 9a). At this location low, live microatolls are moderately abundant (in 1 meter depths) with rubble and shingle deposits becoming ubiquitous near the surf zone.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The windward ocean terrace in this Section is similar to those of the previous Sections. Coral coverage is high, averaging 50-60 percent, with moderate diversity and

high relief. Close to the southern opening of Qatliirow channel, a tremendous monotypic field of staghorn coral covers the bottom. There appears to be a coral assemblage which exhibits the transition between a windward ocean reef and a channel wall (YCRI Stations 10,11) adjacent to the channel entrances of Peelaek, Qatliirow, and Qeetuun. Coral species observed near the wall are more stout and robust with encrusting species being conspicuous to accommodate wave and current stresses. The ocean reef, on the other hand, exhibits a complex of towering coral pinnacles, delicate branching species, table corals, and foliaceous whorls because of calmer water conditions.

**Reef Pass (Dubchol)**

There are three ocean reef passes in Section 4: Peelaek, marking the northern boundary; Qatliirow, which leads into Tamil Harbor; and Qeetuun which branches into Gabaeh and Changad Channels. The entrance passages are quite narrow, ranging from 200-300 meters (666-1000 feet), which makes passage into the channels extremely hazardous for large vessels. Qatliirow Channel has the only regularly serviced navigational aids, but travel into the Tamil Harbor is still recommended for experienced navigators during daylight hours only [23].

Stout microatolls and hard current and wave resistant reef rock pavement, fortify the margin of both channels. The narrow channel entrances generally shoals landward to about 5 meters (15 feet) before terminating as the steep, vertical walls of the inner embayment. Little coral colonizes these outside walls other than encrusting forms which veneer the wall leading into the embayment. Lush coral coverage was observed, however, in several of the more protected, backwater areas of the channel.

## FLORA

### Fringing Reef

**Mangrove Forest (Malil)**

Although Section 4 has the largest embayment and greatest adjacent land area, mangrove forests are relatively undeveloped in all but a few localities. A narrow mangrove band borders much of the eastern inner Qatliirow embayment. A small stand also occurs at the headlands of Chamorro Bay which fronts the urban center of Colonia. Additionally, the northern portion of the Tagireeng Canal, which opens into the Miil embayment, supports a moderate mangrove forest.

The largest mangrove forest in Section 4 and Yap Proper's second largest occurs just south of Peelaek Channel from Maaq village to Dechumur village. The forest penetrates 500 meters (1650 feet) inland and roughly 1.3 kilometers (0.8 miles) along the shoreline. Mangrove cutting and clearing has been reported in this area [124].

**Reef Islets**

Three small islands located within the Qatliirow embayment are narrowly ringed by mangrove forests. Paakael Island slopes gently to its mangrove rimmed shoreline while Tagireeng Island has only its northwestern side surrounded by mangrove forests. Dome-shaped Biy Island is completely encircled by mangrove [65,36].

**Reef Flat**

Extensive seagrass beds of mixed species fringe the coastline and frequently extend to the outer channel margin of Qatliirow Channel and Tamil Embayment [110]. The dominant seagrass is Thalassia hemprichii with two other seagrasses, Cymodocea rotundata and Enhalus acoroides, being both abundant and commonly intermixed together. A moderately diverse assemblage of macroalgae are commonly found among the seagrasses including the green algae Caulerpa racemosa, Halimeda opuntia, H. macroloba, the brown alga Padina tenuis and the red algae Gracilaria salicornia, and Gracilaria sp.

Observations of Chamorro Bay revealed two species of algae, Caulerpa racemosa and Padina sp., growing in 1-2 meter (3.3-6.6 feet) depths at YCRI Station 10h. This is the first record of algae growing in Chamorro Bay which suggests that the Bay is less polluted today than in the recent past.

**Enclosed Lagoon Holes (Makef)**

Few algae are present in the lagoon holes of Tamil embayment which tended to

exhibit both murky and sediment laden conditions. An unidentifiable turf, about 2 mm high, carpeted isolated areas with the calcareous green alga Halimeda discoidea being common in crevices. The blue green alga Microcoleus lyngbyaceus is present, but considered rare.

**Seaward Fringing Reef**

The algal community is usually sparse near the fringing reef margin, typically leaving a relatively barren zone of sand, rubble, and solid reef rock along the reef edge. Calcareous algae such as Porolithon spp. and Hydrolithon spp. veneer most exposed surfaces, while the brown alga Turbinaria ornata can be found growing in pit-like depressions on the reef edge.

## Ocean Reef Slope (Waru 'e naa')

**Ocean Slope**

The ocean reef slope is heavily dominated by live corals and does not normally support a readily observable algal community. Underneath overhanging ledges of the coral reef, the fan-shaped brown alga Lobophora variegata and an unidentifiable algal turf (1 mm thick) adheres to the hard substrate.

## CORALS

### Fringing Reef

#### Reef Flat

Little or no coral is found on much of the sediment and seagrass dominated inner reef flat fringing the southwestern coastlines of Ruul and Tamil municipalities. The inshore areas have only 1 to 10 percent coral cover, which generally increases to 2 to 10 percent farther from shore. Low Porites microatolls are responsible for most of this substrate which forms a slightly submerged platform. Close to the channel margins, overall hard coral coverage increases to 25 percent wherever soft corals (Sinularia polydactyla) are absent. Elsewhere on the reef flat, open sand flats contain isolated coral patches with 10 percent coverage. Open reef corals confined to these areas include columnar and branching Acropora palifera, ramose A. valida, corymbose A. surculosa, and massive heads of the brain corals Platygyra, Leptoria, and Favites.

#### Inner Qatliirow Embayment

The inner embayment of Qatliirow Channel and Tamil Harbor comprises several habitats which vary locally depending upon their location within the embayment system. A trend exists for each habitat to become increasingly depauperate by moving further into the interior reaches of the embayment toward the Tagireeng Canal. The corals for the reef flat, enclosed lagoon holes, and channel wall ecotypes are described below.

The inner reef flat width varies little throughout the embayment, reflecting similar terrestrial and fresh water influences in all areas. As mentioned in previous sections, daily exposure during low tides and terrestrial runoff severely restrict lush shallow water coral development in this area. Microatolls of the hardy species Porites lutea seem to be the only consistent exception to this observation. Other species can occasionally survive the muddy zone which fringes most of the high islands, but are considered rare. Healthier and more diverse coral assemblages are found on the middle reef flat platform and bisect the Qatliirow Channel and surrounds the two islands of Paakeal and Taraang. Continuous water currents across the reef flat, flushes the reef and promotes a more suitable habitat for coral colonization and growth. As in other reef flat margins, Porites lutea predominates while fire coral (Millepora), Goniopora, Psammocora, Leptastrea, and Goniastrea are also present. Further inland, the coral coverage diminishes rapidly due to heavy silt and mud concentrations which tend to smoother live corals. Some small heads of Porites thrive in this region, but are absent inside the Tagireeng Canal.

A lagoon hole adjacent to the shoreline (YCRI Station 10d) and one on the mid reef flat platform (YCRI Station 10c) were sampled revealing very different habitats. As expected, the proximity of a lagoon hole to terrestrial and freshwater sources does dictate the type of fauna and flora present. In this case, the hole closest to the high island (YCRI Station 10d), is shallow and filled with sediment. Very few living corals other than Porites lutea and P. cylindrica are found here. Conversely, on the mid reef flat platform, a small hole which had a maximum depth of 15 meters (50 feet), is completely rimmed by living Porites and Montipora. There is surprisingly high coral coverage here, estimated at roughly 50 percent, for such an interior location in the embayment system. Common corals include Porites, Fungia, Pavona, Favia, Montipora, Lobophyllia, Pectinia, and Mycedium on the slope. Further down, a talus slope merges with a sand bottom floor.

Channel walls of the inner embayment generally slope fairly steeply at a 70 to 80 degree angle to the channel floor. Consistently, a narrow coral band of varying widths rims the upper edge. Porites lutea heads are the predominant coral species, although small mounds of Favia and Montipora are also present. The slope consists mostly of sediment talus at its maximum angle of repose upon which growing corals are precariously lodged; eventually, these corals probably tumble down slope. Coral abundance is low, averaging 25 percent, but high in diversity. Abundant species are Porites cylindrica, Pachyseris speciosa, Leptoseris scabra, and Favia pallida. Also present are Coscinaraea, Goniopora, Hydnophora, Favia, and Fungia. Conspicuously absent are Acropora species. Further down slope, corals are nearly absent on the talus and fine sediment lagoon floor.

The middle of Chamorro Bay, located adjacent to the western edge of Tamil Harbor, possesses a silt laden reef flat with a gentle shallow slope. Roughly 99 percent of the area is covered with mud due to the trappings of soils from terrestrial and freshwater runoff into the bay. Very few corals are present with total coverage being less than 1 percent. Porites lutea heads are the most common coral found, but are not abundant. The living portions of these colonies are oriented toward the eastern or channel side of the bay. Most colonies live within 1/2 meter (2 feet) of the surface where the maximum depth is only 3 1/2 meters (12 feet). Within the study site, one colony each of encrusting Leptastrea purpurea and Montipora caliculata survived close to the water's surface.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The upper ocean slope consists of hard reef rock substrate with moderate coral

cover, averaging 60 percent. As the depth increases, coral cover also increases to 80 or 90 percent with massive hummocky heads of Porites australiensis, Diploastrea heliopora, and Leptoria phrygia being noticeably abundant. Also abundant are plate-like colonies of Galaxea fascicularis and branching columnar colonies of Porites (S.) rus. Corymbose and ramose Acropora continue to dominate the ocean reef slope. Soft corals of the genus Sinularia are abundant, while soft corals of the genera Sarcophyton and Lobophytum are also found. In roughly 9 meters (30 feet) depths, between Qatliirow and Qeetuun Channels, there is a huge monospecific field of staghorn Acropora.

**Reef Pass (Dubchol)**

A transition slope habitat appears between the windward ocean reef slope and the channel wall. High coral coverage averaging 50 to 60 percent and moderate diversity characterizes the area which has both high relief and substratum diversity. The shallow upper zone is covered by a diverse assemblage of corals which converge around sand depressions of varying dimensions. High coral relief is provided by the dominant colonies of Porites (S.) rus which tower several meters above the bottom. Elsewhere, the hummocky mounds of P. australiensis and Galaxea fascicularis in foliaceous and encrusting forms are abundant. Additional complexity is added by Goniastrea, Leptoria, Favia, Millepora, and Stylophora. The steep walls of the pass itself have less coral cover due to scour from strong tidally influenced currents. Encrusting corals like Montipora and non-reef building octocorals are commonly encountered. Coral cover decreases as the vertical walls descend to deeper pass depths.

## OTHER INVERTEBRATES

### Fringing Reef

**Mangrove Forest (Malil)**

Several sponge species are associated with mangrove formations in Tamil. A blue finger sponge is the most commonly encountered species, occurring subtidally on prop roots of the red mangrove Rhizophora. Adjacent to the mangrove formation lies a narrow zone covered by fine silt that appears to be an ecotone between mangrove and seagrass communities. This silt-covered zone is occupied by scattered individuals of a purple finger sponge and a light-brown sponge. A yellow finger sponge and a black sponge may be found in the edge of the seagrass meadow adjacent to the silt zone. A single species of sponge is associated with mangrove formations of Weeloey (YCRI Station 16b). This species, a light-brown sponge, occupies the substrate immediately adjacent to the mangroves.

The clinal gradient between the silt zone and the seagrass community also provides habitat for cnidarians other than scleractinian corals. The benthic scyphozoan Cassiopea medusa can be observed pulsating with its aboral surface on the substrate. The hells'-fire anemone Actinodendron sp., which is capable of inflicting very painful stings, is associated with reef rocks in this ecotone.

The mangrove fringe supports a number of gastropod species, with the predominant species belonging to the detrital-feeding guild. The detritivorous cerithiid Cerithium coralium is abundant in the silt zone between mangrove and seagrass communities. Aggregations of the cerithiid Clypeomorus pellucida are locally common on subtidal prop roots, while the periwinkle Littorina scabra is locally common on the supratidal surfaces of prop roots. Mangrove oysters occupy the main stems of the mangroves in densities ranging from abundant to common. These oysters are prey for the predatory muricid snails Naquetia capucina and Thais aculeata, which are common to rare in different localities. The trochid Monodonta labio is present on intertidal prop roots, but it is rare. In the silt-seagrass ecotone, scattered individuals of the money cowrie Cypraea moneta can be found. Dead valves of the infaunal tellinid clam Quidnipagus palatum are scattered on the substrate near several mangrove hummocks growing in the edge of the seagrass community.

The red-eyed xanthid crab Eriphia sp. was observed among rocks of a manmade jetty extending from the mangrove formation (YCRI Station 9b). Other crustaceans that are present, but rare include grapsid crabs inhabiting prop roots of Rhizophora. The portunid crab Thalamita sp. is scattered in the silt-laden zone adjacent to the mangrove formation.

The mangrove-seagrass ecotone is occupied by an abundance of the sea cucumber Holothuria scabra. Occasional individuals of the sea cucumber Holothuria atra may be observed in this habitat as well.

The distal ends of Rhizophora prop roots that extend subtidally but do not reach the substrate are occupied by clusters of the didemnid ascidian Didemnum candidum. These tunicates are abundant where suitable habitat exists.

**Reef Flat**

Sponges on the reef flats of Tamil are dominated by a black finger sponge. This species is abundant in association with coral colonies on limestone pavement and with algal-covered pavement. An encrusting brown sponge is also common in the former habitat, while a branching green sponge resembling Clathria cervicornis is common in the latter. Styloterra agminata may be found scattered among the corals on hard substrates.

Sponges comprise a major element of the macroinvertebrate fauna on reef flats of Weeloey (YCRI Stations 10b, 10c, 10d, 10f, 10h, 10j, 10k). A black sponge occurs on all reef flats examined, and its densities range from abundant to common at all but one station where it is occasionally observed. Other species of sponges are locally abundant, and these include a brown finger sponge, an encrusting brown sponge, a brown sponge, and Styloterra agminata. A blue sponge is common in localized areas, and a purple finger sponge is scattered in seagrass meadows. A red sponge is present but rare.

Few cnidarian macroinvertebrates inhabit reef flats. The scyphozoan Cassiopea medusa can be found in seagrass meadows of Weeloey, but it is not common. Although not diverse on reef flats of Tamil, octocorals are locally abundant. Sinularia spp. are abundant on reef rocks of the inner reef flat and common on the outer reef flat. Colonies of Lobophytum spp. are scattered among the Sinularia, and Stereonephthya spp. are present but rare. Xenia sp. is abundant in the strong currents and clear waters of the outer reef flat.

Scattered individuals of Sabellastarte sanctijosephi may be found on reef rocks of the inner reef flat. These feather-duster worms were the only epibenthic polychaetes noted, and none were observed on the outer reef flat.

Molluscs are the most diverse faunal element of the macrobenthos on the Tamil embayment reef flats. Gastropods of the inner reef flat are lower in diversity and in abundance that those of the outer reef flat. The sessile vermetid Dendropoma maxima is common on reef rocks and coral heads of the inner reef. A few individuals of the topshell Tectus pyramis and the tiger cowrie Cypraea tigris can be found in recesses of reef rocks.

Conspicuous molluscs on Weeloey reef flats are suspension feeders. The tube-dwelling vermetid Dendropoma maxima and the coral-boring scallop Pedum spondyloideum may be encountered on scattered massive coral colonies.

The outer reef flat is occupied by large numbers of Dendropoma maxima on coral heads and reef rocks. Limestone pavement provides habitat for Cypraea tigris, the thorny oyster Spondylus squamosus, and the giant clam Tridacna squamosa. Species that are present, but rare include the black-lipped pearl oyster Pinctada margaritifera and the giant clams Tridacna crocea, Tridacna maxima, and Hippopus hippopus. The blood-mouth conch Strombus luhuanus is abundant in sandy substrates of the outer reef flat, and the humped conch Strombus gibberulus is commonly observed.

Although they are not abundant, echinoderms constitute the most conspicuous macroinvertebrates of the reef flat. The seastar Linckia laevigata, the urchin Echinothrix diadema, and the sea cucumbers Bohadschia argus and Holothuria nobilis can be found on both inner and outer reef flats. Species found only on the inner reef flat include Culcita novaeguineae, Bohadschia marmorata, and Thelenota anax, while Ophiocoma sp. and Echinometra mathaei occupied the outer reef flat only.

Echinoderms are the predominant macrobenthos of the Weeloey reef flat. The sea cucumber Holothuria edulis is the most abundantly occurring species. Widely dispersed species include the seastar Protoreaster nodosus and the sea cucumber Holothuria atra, both of which are abundant in localized habitats. Seagrass meadows support numerous echinoderms. Less widespread but abundant in restricted areas are the short-spined urchin Mespilia globulus and the sea cucumbers Actinopyga sp., Stichopus chloronotus, and Stichopus variegatus. The reef flat also provides habitat for the seastars Culcita novaeguineae and Linckia multifora and the urchin Echinometra mathaei, but these species are not common.

**Reef Margin**

Reef margins of Weeloey are inhabited by numerous sponges. A brown finger sponge, an encrusting brown sponge, and a black sponge are common on the reef margin. The orange species Styloterra aginata is common, and a red species is present but rare.

Soft corals of the genus Sinularia may be observed on the reef margin. They can be found on a substrate of reef rock. This habitat is shared with scattered individuals of the feather-duster worm Sabellastarte sanctijosephi and the suspension-feeding molluscs Dendropoma maxima and Pedum spondyloideum.

The sea cucumbers Holothuria edulis and Holothuria flavomaculata are abundant on the reef margin. Their congener, Holothuria coluber, may be found extending from beneath large coral heads.

**Inner Tamil Embayments**

Few macrobenthos inhabit the turbid waters of small embayments with restricted water circulation. Sponges appear to be the best-adapted macroinvertebrates for such conditions. A black finger sponge occupies the fine silt substrate in densities ranging up to abundant in localized areas. A testillid sponge resembling Cinachyra spp. and Styloterra aginata may be encountered in this habitat. A blue finger sponge is present, but rare.

The benthic scyphozoan Cassiopea medusa can be found in shallow areas of embayments, but they are not common. The hell's-fire anemone Actinodendron sp. is also scattered in shallow areas.

The hermit crab Dardanus megistos was observed on a fine silt substrate near the shoreline. This was a small individual occupying a Trochus niloticus shell 4 cm in diameter.

Echinoderms are restricted to less turbid waters of embayments. Juveniles of the sea cucumber Stichopus variegatus can be found here, but they are not common. Culcita novaeguineae and Actinopyga sp. are present, but rare.

**Tamil Channel**

Sponges are the predominant macroinvertebrates of Tamil Channel. Brown and pink encrusting forms are abundant, and the orange sponge Styloterra aginata is common. A black sponge and a larger species, denoted as the black bath sponge, are scattered in this habitat. Sponges also grow on the upper slopes of inner Tamil Channel in Weeloey. A black sponge species is common on hard substrates of the upper slope, and an encrusting brown sponge, an encrusting pink sponge, and a red sponge are scattered throughout this habitat. Dysidea herbacea is present, but rare in this area.

The wire coral Cirrhipathes sp. is the most abundant of the cnidarian macrobenthos. These antipatharians spiral outward from their holdfasts on hard substrates along the channel walls, where they attained their greatest abundance at depths of 12-18 meters (40-60 feet) . The soft coral Sarcophyton spp. and the clownfish anemone Heteractis magnifica may be encountered along the upper margin of the channel.

The feather-duster worm Sabellastarte sanctijosephi was the only conspicuous polychaete of the channel habitat. These annelids can be found scattered on limestone

along the upper shallow margins of the channel walls. These polychaetes are present in this zone, but they are not common.

All conspicuous molluscs observed in this habitat are suspension-feeders. The sessile vermetid Dendropoma maxima is common on limestone substrate of the upper channel margin. The large thorny oyster Spondylus varius is abundant beneath limestone ledges of the channel wall. These bivalves, attaining a maximum diameter of some 25 cm, reached their greatest densities at depths of 9-18 m. Overlapping the depth range of Spondylus varius is another large bivalve, the bear-claw oyster Hyotissa hyotis, which is found at 12-18 meter (40-60 feet) depths. Occasional individuals of the cockscomb oyster Lopha cristagalli and the coral-boring scallop Pedum spondyloideum can be observed on the upper channel slope and on the channel margin, respectively.

Bivalves were the only conspicuous molluscs inhabiting the inner channel walls in Weelocy. The coral-boring scallop Pedum spondyloideum is commonly observed embedded in poritid corals of the shallow channel margin. The thorny oysters Spondylus cf. squamosus and Spondylus varius are scattered on limestone substrate of the channel slope. A large (18-cm shell length), flat oyster occupies the vertical faces of a sunken barge in the channel.

Tamil Channel supports an array of echinoderms. The sea cucumber Holothuria flavomaculata is abundant among shingle of the channel slope and margin. It congener Holothuria edulis is common on a similar substrate but at shallower depths. Occasional individuals of the seastars Culcita novaeguineae and Fromia sp. and the urchin Echinometra mathaei can also be found along the channel margin.

### Ocean Reef Slope (Waru 'e naa')

Sponges do not constitute a major group of macroinvertebrates on the ocean terrace. Except for an area near the pass to Tamil Channel where Dysidea herbacea was abundant, sponges were rarely encountered. Elsewhere, Dysidea herbacea was rare, and a black sponge occurred only on one station.

Conversely, the fore reef slope is occupied by many cnidarian macrobenthos. The stoloniferan Clavularia sp. is widely distributed and locally abundant. Soft corals of the genus Sinularia are ubiquitous on the fore reef slope. Sympodium coeruleum is abundant in localized areas, and Xenia sp. is locally common. Scattered individuals of Lobophytum spp., Sarcophyton spp., and Stereonephthya spp. may be encountered as well.

The distribution of epibenthic polychaetes of the ocean terrace in Tamil is similar to other areas. The Christmas-tree worm Spirobranchus giganteus can be found growing in

massive coral colonies, and the feather-duster worm Sabellastarte sanctijosephi is present but rare.

The commercial topshell Trochus niloticus is the most widely dispersed mollusc of the fore reef community. The trochid Tectus pyramis is found in the same habitat as Trochus niloticus, but it occurs in lower numbers. Occasional individuals of the giant clam Tridacna maxima may be encountered on the fore reef slope.

Spiny lobsters of the genus Panulirus can be found at the entrance to vault-like cells in the fore reef slope. The hermit crab Dardanus megistos was observed occupying shells of Trochus niloticus and Lambis truncata.

The most diverse group of macroinvertebrates on the fore reef slope is the Echinodermata. Although no species was considered common, several were widely distributed in this habitat. The upper reaches of the fore reef slope are occupied by the urchin Echinothrix diadema and the sea cucumbers Stichopus chloronotus. Lower on the slope and on the terrace, the crinoid Comanthus cf. parvicirrus, the seastars Linckia multifora and Acanthaster planci, and the sea cucumbers Holothuria nobilis and Stichopus variegatus may be found.

Dead coral heads and reef rocks on the fore reef slope are substrates for the ascidian Didemnum molle. These tunicates varied from abundant to rare on Tamil ocean terraces.

## FISHES

### Fringing Reef

**Mangrove Forest (Malil)**

The fringing mangrove forest dominates the inner margin of Qatliirow Embayment and also fringes the perimeter of Taraang Bay and portions of Paakeal Islands. The mangrove prop roots provide abundant cover for larval and juvenile fishes as well as for some adults. Several species of cardinal fishes (Apogonidae) and gobies (Gobiidae) are abundant. Commonly observed along the outer margin of the mangroves are rabbit fishes (Siganus canaliculatus, S. spinus), snapper (Lutjanus fulvus), and monocle bream groups (Scolopsis ciliatus) which tended to hover close to the water's surface. Half beaks (Hemiramphus sp.), mojarras (Gerres sp.), archer fish (Toxotes jactator), and the surgeon fish Acanthurus blochii occurred infrequently as did scats (Scatophagus argus).

**Reef Flat**

Fish populations associated with the inner fringing reef of Qatliirow Embayment are not as abundant or diverse as other reef flat areas. The inner reef flat areas, which lack vertical relief and extensive live coral development, are relatively depauperate of fauna. The seagrass beds fringing the mangrove forest and coastline frequently extend to the edge of the channel. Due to tidal fluctuations, however much of these flats are exposed or nearly so during low tides. Consequently, the species diversity is low and restricted to smaller adults, and many juvenile fishes. Throughout the YCRI reef flat stations (10b-12, 18, 10a), between 8 and 18 fish families are present with an average mean of 13 families. Butterfly fishes (Chaetodon auriga, C. ephippium, C. kleinii), and damsel fishes (Amblyglyphidodon curacao, Chrysiptera cyanea and Pomacentrus pavo) commonly dart between the seagrass microatolls and branching corals closest to the channel margin. The seargent-major (Abudefduf sexfasciatus) and the aggressive and territorial Stegastes lividus (damsel fish) is particularly common. Also present are several species of wrasses (Labridae), surgeon fishes (Acanthuridae) and parrot fishes (Scaridae). A school of fusiliers (Pterocaesio tile) cruised by in deeper waters along the channel wall while small groups of emperor breams (Gnathodentex aureolineatus and Monotaxis grandoculis) moved throughout the area.

**Enclosed Lagoon Holes (Makef)**

The coral coverage varied significantly between the two YCRI lagoon hole stations (YCRI 10c and 10d), yet the fish assemblages are quite similar. In both holes the most

diverse families are Acanthuridae (surgeon fish), Apogonidae (cardinal fish), Chaetodontidae (butterfly fish) and Labridae (wrasses) with each having 5 species. The following species are commonly found in these lagoon holes: Ctenochaetus striatus, Zebrasoma scopas (surgeon fishes), Sphaeramia nematoptera, Apogon leptacanthus, Apogon sp. (cardinal fishes), juvenile Scarus sp. (parrot fishes), and the damsel fish Amblyglyphidodon curacao. Larger edible species present included jacks (Gnathanodon sp.), rabbit fishes (Siganus canaliculatus, S. puellus), snappers (Lutjanus fulvus, L. gibbus), and goat fishes (Parupeneus multifasciatus, P. barberinus).

**Chamorro Bay**

Within Chamorro Bay (YCRI Station 10h), three fish families were reported (Apogonidae, Gobiidae, and Tetraodontidae) residing on the mud/silt bottom of the bay. Just outside the bay adjacent to the MRMD deck, the fish population increased to 13 families. The damsel fish Amblyglyphidodon curacao and the cardinal fish Sphaeramia nematoptera were observed commonly, as well as Asterropteryx semipunctatus (Gobiidae).

**Outer Fringing Reef**

**Mangrove Forest (Malil)**

The most noticeable difference between the Qatliirow Embayment mangrove stations and YCRI 9b, located off Yimuch, was the water clarity. A juvenile bat fish (Platax orbicularis) and cardinal fishes (Apogonidae) darted amongst the prop roots while blennies (Blennidae) and gobies (Gobiidae) clung to them or rested in shrimp holes. Small schools of rabbit fishes, consisting of 10 - 20 individuals, swam between the root network (Siganus spp.)

**Channel Margin**

Massive coral formations including mounds and thickets with little vertical relief colonized extensive areas adjacent to Peelack Channel (YCRI Station 9c). Complimenting this area are large colonies of soft corals. At least fifteen fish families are represented covering 80+ species at this station.

Damsel fishes (Pomacentridae) and wrasses (Labridae) are the most diverse families, each having 17 species, although damsel fishes are clearly the most commonly encountered fish overall. Closely associated with the coral structure are surgeon fishes (Acanthurus blochii, A. triostegus, Ctenochaetus binotatus, C. striatus), wrasses of the

genus Thalassoma, and gobies (Acentrogobius sp.). Goat fish schools (Mulloides flavolineatus, Parupeneus barberinus) and monocle breams (Scolopsis sp.)cruised along the adjacent sandy areas.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

On the wave exposed outer reef flat off Tamil-Gagil, eighteen fish families were observed. Wrasses (Labridae) exhibit the most diversity with 19 species, followed by damsel fishes (Pomacentridae) with 15 species, and butterfly fishes (Chaetodontidae) with 11 species. Juvenile parrot fishes (Scarus spp.), the neon blue Chromis viridis, black Stegastes nigricans (damsel fishes), and the territorial Ctenochaetus striatus and Gnathodentex aureolineatus are the most abundant species present. Many fishes commonly associated with the coral formations include Gnathodentex aureolineatus, small schools of goat fishes (Parupeneus spp., Mulloides sp.) and a hawk fish (Paracirrhites arcatus) which sits close to the sand patches. Curled among the coral heads are numerous pipe fish (Corythoicthys intestinalis) while squirrel fishes and cardinal fishes (Sargocentron spp. and Apogon sp.) congregate underneath ledges. A large school of fusiliers (Pterocaesio marri) passed quickly through the area. The overall fish diversity decreased significantly within closer proximity to the wave-swept reef pavement zone.

**Ocean Reef Slope (Waru 'e naa')**

**Ocean Slope**

Seaward of the high-energy, wave-washed zone, the fish community diversity increases again on the sloping reef terrace. A well developed coral community provides extensive habitats for many more families than the 20 conspicuous fish families observed, which represented 105 different species. Several larger fish species occur abundantly such as Pseudanthias dispar (grouper), and schools of emperor breams (Gnathodentex aureolineatus and Monotaxis grandoculis), and surgeon fishes (Acanthurus thompsoni, A. triostegus, Ctenochaetus binotatus, Naso brevirostris).

The ubiquitous school of pyramid butterfly fishes (Hemitaurichthys polylepis) also occurred at both Section stations (YCRI 9, 10). Aggregations of the damsel fishes Amblyglyphidodon curacao, Abudefduf saxatilis, and Chromis atripes darted between branching coral species. Underneath coral ledges, squirrel fishes are commonly found (Myripristis spp., Neoniphon sp.), as are black bronze sweepers (Pempheris oualensis). A school of fusiliers zipped through the survey region (Pterocaesio tile) as did a solitary bat

fish (Platax orbicularis). A pair of yellow Siganus vulpinus (rabbit fish) marshalled the survey region's perimeter, and a few angel fishes occured near coral reef pinnacles and mounds.

## OTHER MARINE VERTEBRATES

Green sea turtles (Chelonia mydas) are known to inhabit the ocean and lagoon waters of this Section. A single intermediate sized turtle was spotted off YCRI Station 9 while a small turtle was being kept captive at the ESA Hotel in a dish pan. Further investigations revealed that the turtle had been captured within Qatliirow embayment. An unidentified pod of porpoises or dolphins was also sighted off YCRI Stations 7 and 6.

## ARCHAEOLOGICAL AND HISTORICAL SITES

This map section contains two of the three dominant centers of Yap's internal alliances -- the Tamil and Ruul centers, or more specifically the village pairs of Teab/Meqruur in Tamil and Ngolog/Balcabaat in Ruul.

Very little archaeological research has occurred in Tamil. Test excavations were dug in 1956 in one site in Teab village (Rugog's grave) which yielded dates in the A.D. 1700s [42]. A survey of the proposed Tamil water system occurred in 1980 and located some burial sites [72]. Clearly, oral history points to the importance of Tamil as a political center which had powerful magicians and an area called Gachaam, which had many sacred places.

No archaeological research has been done in eastern Fanif and Weeloey. In the 1800s, this area generally contained low ranking villages -- *daworcig* (commoner) villages or serf and servant villages -- with the exception of Dugor, which was a higher ranking village.

In contrast, considerable archaeological work has occurred in northern Ruul. Archaeological reconnaissance surveys have been done in the housing areas of Baleabaat [14,16,17], Taalguw [16,17], and Baqanimaqut [58,59] and in the housing and savanna areas of Gitaem [15-17]; and a detailed survey was done in Gitaem [59]. Limited excavations have taken place in Baleabaat [42] and Gitaem [59]. Dates from surface sites indicate that these sites date back at least to the A.D. 1500s-1700s. The most striking coastal features identified in Baleabaat and Gitaem are faeluw, which are built on created land extending out from shore -- poking out slightly from the shore-cloaking mangroves. Also, the larger taro swamps of Baleabaat are said to be reclaimed land, and some archaeological evidence tends to support this claim [16].

## RESOURCE USES

Information for this section was primarily obtained from interviews with fishermen from Tamil, Ruul, Weeloey, and Fanif Municipalities (Appendix F).

### Terrestrial Resource

Currently, the Yap State government owns only 4 percent of the total land area in Yap Proper, with most of this in the Colonia region [83]. Because the State government owns so little property and faces land title problems, it's difficult to develop capital improvement projects. Furthermore, because land is unavailable to offer to prospective entrepreneurs interested in locating small commercial businesses in Yap, it's difficult to attract businesses. Consequently, to alleviate some of the public land shortage problem, the State has instituted several land fill projects in Colonia to create land. For example, the legislative buildings and the new fisheries center are now located on newly created land. These created lands will have a very valuable purpose in Yap. However, land filling also has adverse environmental impact on the adjacent reef flat areas. Hence, caution is recommended in undertaking any future land filling operations. Moreover, the derived benefits of the new land should be carefully analyzed against the loss of fisheries habitat and other values.

Several factors make the Colonia area a prime spot for additional resort/tourism development which would compliment the two existing hotels already located in this Section. Of paramount importance is an airport which is connected by a paved road to Colonia, facilitating access between the two localities. Secondly, infrastructure such as sewerage, water and electricity are already in place in Colonia, although the service is intermittent. Services such as food stores, taxis, and the island's only dive shop are located in Colonia. Other services such as tour guides and interpreters, and boat rentals could be initiated. Colonia is near many points of interest including the stone money bank in Baleabaat and Taraang Island, home to "His Majesty O'Keefe", both of local historical significance. The Colonia area, however, does have some drawbacks. Chamorro Bay for example, is unattractive and has poor water quality. Furthermore, there are no beaches or attractive dive sites in the vicinity.

### Fringing Reef

#### Mangrove Forest (Malil)

Mangrove forests are relatively undeveloped in all but a few localities. Yap Proper's second largest and Section 4's largest mangrove forest occurs just south of

Peelaek Channel from Maaq village to Dechumur village. Currently, the mangrove forest in this area is reported to be commercially harvested [125]. Unfortunately, there is no record of the extent of harvesting being carried out or how long it will continue [125]. Although these mangrove forests are extensive and may have the potential for small scale commercial logging, the sustainable yield of these resources should be determined prior to allowing the continuance of commercial activities. Furthermore, these areas provide habitat for several crab species. Land crabs (*galip*) are plentiful from April to August and harvested in great number. Mangrove crabs (*qamaang*) are also found in the mangroves, particularly in southern Tamil.

**Reef Flat**

Many fish species are caught throughout the reef flat in this Section. Coral patches and complexes provide abundant habitats for many highly prized eating fishes. Closest to the shoreline, rabbit fishes and goat fishes are considered to be plentiful by fishermen. Usually they are harvested with gill nets and surround nets. Other species caught are parrot fishes, rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), goat fishes (*manguch, mbing, soong*), stickfishes (*buuy)*, emperors (*wul, qoeyeq, gadgad*), and milk fishes (*guuguw, tangir*). Fishermen report these fish are abundant and typically caught by spear fishing and gill netting, and to a small extent by stone fish traps. Snappers (*gooychaaf, gadaw*) are found throughout the deeper nearshore areas on the reef flats and in "blue holes." Usually, they are caught by handline, but are also harvested by spear fishing and infrequently, by surround net. Jacks (*ngool, m'uul, qelqel*) are found on the reef flats near coral heads and are harvested using handline or by spear fishing.

Several sites in this Section have been previously dredged to provide fill for a number of construction projects. These include the area near the Meqruur village causeway, by the new hospital at Keeng outside of Colonia, near Dugor in Weeloey municipality, near Baleabaat in Ruul, and along the Tagireeng Canal which separates Yap and Gagil-Tamil Islands. A description of these sites can be found in a consultants report on dredge sites in Yap [105]. For the Meqruur and Dugor sites, it was reported that subject to special conditions, these areas could be reused [105].

Sand is an important ingredient for making concrete which is used in construction projects worldwide. A large sand deposit, which has been mined for a number of years, lies on the northern reef flat outside Tamil Harbor [105,37]. Interviews with the sand mining contractor, revealed that sand is dredged by his company (WAAB Transportation)

twice monthly [1]. Currently, this is the only place sand is extracted on Yap. The size of the deposit has not been determined. This sand deposit site is considered to be an unproductive area by local fishermen.

**Tamil Harbor**

A rich assemblage of harvested fish species are caught within the Tamil Harbor region. Schools of sardines (*saadiin)*, anchovies (*malmeq*), and flagtails (*faakeayaan, liyeq*) are found in abundance. A small commercial baitfish fisheries could be feasible if the standing stock is determined to be sufficiently large and if harvesting regulations are setforth by MRMD. These fish could be easily used as bait fish for tuna fishing, in addition to consumption by local fishermen. Other species also mentioned by fishermen are juvenile fusilier (*foofow*) and jacks which are harvested by gill net or hand line in the harbor.

Tamil Harbor itself, represents a natural resource of extreme importance to the State of Yap. The natural harbor features a protected inner embayment which has a safe, deep anchorage for large vessels. Additionally, Tamil Harbor is the main port of entry for consumer goods and imported food items into Yap State. The harbor should continue to be maintained and hazards to safe navigation such as spurs in the channel walls should be removed.

Several channel widening projects in Tamil harbor are under consideration to facilitate vessel passage. The widening would involve removing spurs on the coral reef that are a hazard to navigation in the harbor. The coral material removed should be stock piled on land and used as fill for construction projects in Colonia and for road improvements throughout Yap Proper.

**Enclosed Lagoon Holes (Makef)**

A variety of fish species are harvested within these enclosed lagoon holes. Angel fishes (*buloch, qeer*) are commonly caught here as well as snappers (*gooychaaf, gadaw*) and groupers (*smaak'uw, k'uw*). Spear fishing is the prime method of capture for angel fish, while hand line and spear fishing is used for harvesting snappers and groupers in these areas. Jacks (*ngool, muul, qelqel*) are harvested by using a hand line or by spear fishing.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

A complex of coral thickets or coral patches and mounds are scattered throughout the outer reef flat. Fishermen reported catching groupers (*smaak'uw, k'uw*) in deeper

areas along the reef flat, by using a handline. Groupers, however, are less abundant than snapper, which are also caught in this area. Other abundant harvested species are parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*quum, machagwog, bilaew, maath*), squirrel fishes (*yooch*), angel fishes (*qeer, buloch*), wrasses (*numean*), and rudder fishes (*guumiy*). Normally these are caught by spearing and gill netting or surround nets.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The ocean reef fisheries are abundant and diverse. Fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*machagwog, maath, bilaew*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), and goat fishes (*manguch, mbing, soong*). Gill nets and spear fishing are the preferred fishing method, with groupers (*smaak'uw, k'uw*) being caught with a handline. Snappers (*gooychaaf*) are caught on a handline at the reef edge. Barracuda (*qanger, maal*) are found seaward of the ocean slope, close to the edge and are caught infrequently as a by-catch while trolling for tuna. Trochus or topshell (*yogyog*) is harvested for commercial purposes along the reef's edge. Other species also caught trolling, but farther offshore are tuna (*taguw*), wahoo (*malchath*), and dolphin fishes (*dabaar*). As in other Sections, these species are not often fished because it usually requires a power boat. Also caught infrequently are dog tooth tuna (*yasul*) found off the entrance to Qeetuun Channel. Flying fish (*goeg*) are caught seasonally, January through March, outside the ocean reef. They are usually caught at night using a lantern to attract them, and a scoop net to net them as they fly by or during the day with a scoop net.

## WATER QUALITY

The area surrounding Colonia, the government administrative center and Yap's only large municipality, and the more rural areas nearby, comprise Section 4. Colonia and the harbor area will be treated separately from other parts of this section.

### Colonia and Tamil Harbor Area

Point source pollution in the Colonia area include occasional discharge of oil from the old power plant, oil spills from Mobil Oil storage tanks, sewage treatment plant discharge, over-the-water benjos (toilets) in the area around Madrich, pig pens along the shore at Baleabaat, discharge from commercial shipping, and overflow from sewer lines when sewage pumps shut down during power failures [30]. Falanruw [31] reports that oil spills from the Mobil Oil facility in Colonia may have caused the dieback of mangrove and other vegetation in Chammoro Bay and the harbor area. Non-point sources of pollution include road repair and runoff, oil from filling stations and small outboard motors, and land clearing and filling for construction [30].

The waters in Tamil harbor and around Colonia are Class B. Waters in Chammoro Bay had a far greater fecal coliform and total coliform count than allowed under the standards for Class B waters. Furthermore, the waters around Baleabaat were in excess of the standards on two of the three days tested [18]. In other areas around Colonia and in the upper reaches of Tamil Harbor all parameters were within the standards.

There are five dredged or potential dredging sites in this part of Section 4. Use of any one of these sites could cause increases in turbidity and suspended solids in excess of the standards for those parameters. Appropriate mitigative measure should be instituted before and during dredging. Steps taken after 1980 may have improved the situation of Chammoro Bay and Tamil Harbor with respect to the fecal coliform counts. However, no water chemistry data were collected during the YCRI and no data were available from local sources.

### Rural Colonia

No point source discharges were noted in this area. Non point sources included road repair, small garden and soil preparation runoff, and land clearing for housing construction [30]. The waters in this area are classified as AA. Low dissolved oxygen conditions were reported for this area during one of the three days of sampling at both the sampling sites in this area. All other parameters were within standards for AA waters [18].

**Section 4**

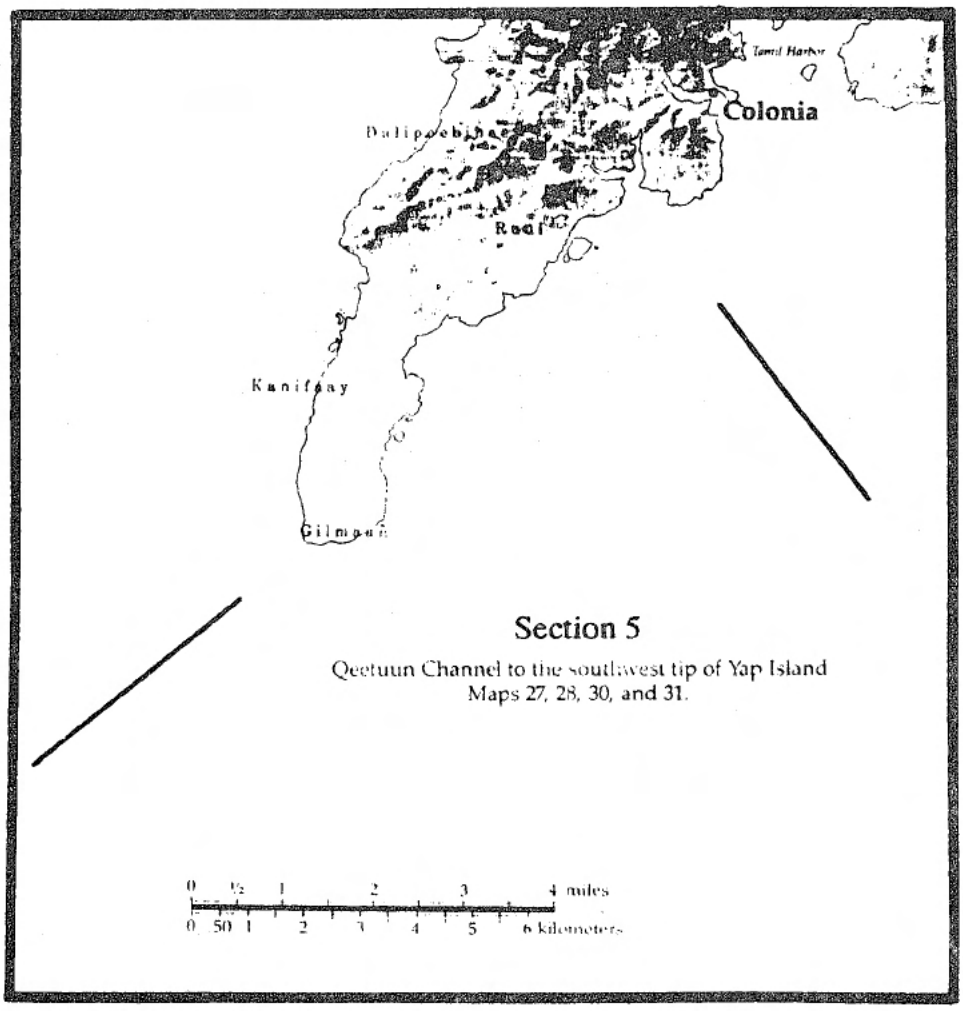
There are no existing or proposed dredge sites in this part of Section 4.

## SECTION 5: SOUTHERN RUUL & GILMAAN

### GENERAL DESCRIPTION

This windward coastline region of Yap Island extends from Gabach Channel in the north and to Yap's southernmost reef extension in the south (Figure 9). The eastern coastlines of Ruul and Gilmaan Municipalities represent the geopolitical regions. Numerous small villages are scattered along the eastern coastline which fronts Gabaeh Channel. A small boat pier extends into the channel's end by Ngoof village. South of the southern-most end of Yap Island, the shallow reef flat extends seaward over one kilometer and is devoid of enclosed lagoon holes.

**FIGURE 9. A MAP OF SECTION 5 WHICH INCLUDES THE AREAS OF SOUTHERN RUUL AND GILMAAN.**



Section 5

## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

Section 5 includes the Yap island land area adjacent to the southwestern (windward) reef flat from Gitaem, Ruul located off the northern finger of Qeetuun Channel, and south to the most southern reef flat extension of Yap Island off Qanooth village in Gilmaan. The offshore rock island of Garim, located approximately 600 meters from Laey village in southernmost Yap, and the southern channel finger of Gabaeh are also included in this Section. Contrasted with the steep northern high hills of Section 4 on Yap Island, this region's topography exhibits gently sloping hills with an average elevation of 40 meters (133 feet) which merges into a southern plateau only 20-30 meters (66-100 feet) above sea level.

On the east coast of the central low hills, the coastal plains are relatively narrow and discontinuous, except at Balcabaat and Yinuuf. On the eastern coast of the southern plateau, however, lie the widest coastal plains on Yap Island. For instance at Ngariy, they are as wide as 150 meters (500 feet), but dwindle to only 50 meters (166 feet) at other places. The only sand beach in this Section fringes the coastline from Laey south to Guroor. Regularly spaced streams drain the central low hills. Stream velocities are low, however, because of the flat topography.

### Fringing Reef

Section 5 exhibits the widest, continuous portion of fringing reef throughout the Yap islands complex. The reef flat extends a distance of 2-3 kilometers (1.25-1.8 miles) seaward with a southern tip reef extension to 3.4 kilometers (2.1 miles) (YCRI Stations 11a, 12, 12a, 12b, 13, 13a). Since the southern reef flat is so shallow, the Yapese frequently cross a 300 meter (1000 feet) passage to the ocean at Magachgil, Gilmaan during low tides and calm ocean seas (YCRI Station 13a). The southeastern finger of Gabaeh Channel parallels the coastline for 4.5 kilometers (2.8 miles) before ending at Ngoof village, in the Municipality of Ruul (YCRI Stations 12a, 11a). Also penetrating the reef flat are four enclosed lagoon holes: Bigeew, Miniy, Riiloel, and Girgir. Garim, the small rock island, is also seaward of Girgir hole.

### Mangrove Forest (Malil)

With the exception of the southern tip of Gilmaan, a continuous mangrove belt lines the entire coastline of Section 5. The most extensive mangrove forest in Yap Proper

penetrates 1.5 kilometers (0.9 miles) inland between the villages of Yinuuf and Luweech. Elsewhere, the band averages 450 meters (1500 feet) in width.

**Reef Flat**

The fringing reef flat is slightly deeper at the edge of the mangrove forest where there is usually an unvegetated band of silt and sand a few meters wide. Seaward towards the lagoon this is superseded by a zone of sea grass and microatolls which grow on a substrate of silt and sand. Further offshore along the landward margin of Gabaeh Channel, low to moderate coral development occurs despite significant concentrations of silt. Typically, this area is a veneer of silt over a framework of dead coral.

On the seaward channel margin, densely packed coral patches align the channel margin (60 percent coverage) with moderate species diversity. A hard reef rock pavement supports the growth of these corals while also serving as a reservoir for broken coral rubble. Seaward, the rubble becomes distributed more randomly with extensive reef rock and sand flats predominating. Thickets and dome-shaped coral colonies extend throughout this back reef flat zone. At the reef margin, rubble and low microatolls become more conspicuous as the depth decreases seaward over a hard reef pavement.

**Enclosed Lagoon Holes (Makef)**

Section 5 has four enclosed lagoon holes located on the seaward reef flat. Likewise, these holes are irregularly shaped with Girgir being the most narrow and elongate of all holes throughout Yap. YCRI Station 12b documented the floral and faunal assemblages of Riiloel Hole, the largest hole in Section 5, which is discussed below.

The top of the reef fringing Riiloel Hole is composed of a moderately diverse live coral assemblage which forms a veneer over the predominant reef rock pavement. Due to shallow water depths, relief is low along the hole's perimeter. Yet, various coral growth forms are present including table, staghorn, massive, and corymbose species.

The reef slope descends steeply in the hole to the sand bottom in water depths of 6-10 meters (20-33 feet). The floor of the hole exhibits variable relief. Live corals include ramose, finger, hemispherical and encrusting plate species and averaging 50 percent coverage on hard surfaces. The hole's floor consists primarily of fine sand and fragments of coral which have tumbled downslope into the hole.

Section 5

**Reef Islet**

The rocky island of Garim is less than 100 meters (333 feet) long lying approximately 1 kilometer (0.6 miles) east of the village of Laey, and located at the southernmost end of Yap Island. The entire periphery of the Garim shoreline is undercut 1-2 meters (5-6 feet) by the sea, while the upper surface is extremely jagged with pinnacles rising 3 meters (10 feet) high. A mixed zone of submerged seagrass meadows turf and pitted limestone pavement depressions surround the island. Few corals colonize the area and are considered an inconspicuous component of the ecosystem.

**Seaward Reef Flat (Lan e rayem \ Daken 'e na')**

Strong currents initiated by wave driven sheet flows of water across the windward reef margin, and restrict coral growth to mostly robust, massive, and corymbose species. At the landward edge of the reef flat margin, in water depths of 1-2 meters (3-5 feet), pockets of live corals proliferate amongst barren zones of exposed pavement. Toward the reef crest, rubble and low microatolls become more conspicuous as the depth decreases on the hard reef pavement. Loose sand, rubble and shingle cover the pavement while probably being transported landward over the reef flat.

**Ocean Reef Slope (Waru 'e naa')**

**Ocean Slope**

The windward fore reef ocean slope gradually descends to greater depths from the reef crest pavement. A zone of isolated, massive coral species firmly affixed to the pavement merges with a fairly developed spur and groove system covered with living corals. The buttresses (spurs) are shallow, but massive and dominated by table coral species. These buttresses are long undular extensions down the reef slope while the grooves are narrow and shallow. An irregular terrace blanketed with 75 percent live coral coverage and sand depressions occurs below 10 meters (30 feet). Coral pinnacles occasionally protrude several meters from the bottom.

**Reef Passes**

There are two ocean reef passes in Section 5: Qatliirow, which marks the northern boundary of this Section and was previously discussed; and Qeetuun which branches into Gabach and Changad Channels. The Qeetuun entrance passage is very narrow, averaging 200 meters (666 feet) in width. The channel is straight for about 1100 meters (3300 feet)

before branching into two channels. Gabaeh Channel parallels the municipality of Ruul while Changad Channel meanders perpendicularly to the shoreline off the village Meer.

Stout microatolls and hard current and wave resistant reef rock pavement, fortify the margin of both channels. The narrow channel entrances generally shoals landward to about 5 meters (15 feet) before terminating as the steep, vertical walls of the inner embayment. Little coral colonizes these outside walls other than encrusting forms which veneer the wall leading into the embayment. Lush coral coverage was observed, however, in several of the more protected, backwater areas of the channel.

Section 5

## FLORA

### Fringing Reef

#### Mangrove Forest (Malil)

With the exception of the southern tip of Gilmann, a continuous mangrove belt lines the entire coastline of Section 5. The most extensive mangrove forest in Yap Proper penetrates 1.5 kilometers (0.9 miles) inland between the villages of Yinuuf and Luweech. Elsewhere, the band averages 450 meters (1485 feet) in width.

#### Reef Flat

Seaward of the mangroves there is usually a narrow (width 2 to 5 meters) band of unvegetated silt and sand, then the beginning of seagrass beds. Seagrass beds featuring a mixture of Thalassia hemprichii, Enhalus acoroides, and Cymodocea rotundata, are well-developed, extending well out onto the fringing reef flat to the shoreline margins of Gabaeh and Changad Channels.

A number of algae species are mixed in with the seagrasses and also extend beyond the seaward limits of the seagrass beds to the margin of the fringing reef, forming a variable algal zone. Growing abundantly under the seagrass blades at YCRI Station 12A is Gracilaria salicornia representing 74 percent coverage. Other species growing among the seagrasses are green algae (Caulerpa racemosa, Halimeda macroloba and Chaetomorpha sp.) and red algae (Gracilaria sp.). Common in localized patches is a species of the green alga Cladophora.

The seaward margins of Gabaeh Channel feature a lush, live coral reef structure with numerous herbivorous fish. Tsuda reports that the common algae found, Gelidiopsis intricata and Polysiphonia spp., are on dead Acropora guarded by territorial damselfish (Pomacentrus sp.). Green algae present, but considered rare are Tydemania expeditionis (found in crevices) and small patches of Caulerpa racemosa.

#### Seaward Reef Flat (Lan e rayem \ Daken 'e naa')

Within 50 meters (165 feet) of the reef margin, adjacent to a relic limestone structure, small clumps of the green algae Halimeda opuntia, H. discoidea, and H. macrophysa and the blue-green alga Microcoleus lyngbyaceus is common (YCRI Station 14A).

### Ocean Reef Slope (Waru 'e naa')

#### Ocean Slope

Similar to other upper ocean reef slopes, calcareous algae covers most reef rock substrates and loose coral shingle pieces. Small patches of the green alga Halimeda sp. are

scattered throughout the reef's interstices. Extensive networks of a fine filamentous blue-green alga, Schizothrix calcicola, which is brilliant red, cover portions of many sand patches at depths of 10-15 meters (30-45 feet).

Section 5

## CORALS

### Fringing Reef

**Reef Flat**

Coral coverage on the inner reef flat is 0 to 1 percent due to the lack of suitable substrate and the influence of silt and fresh water. Porites lutea microatolls continue to be the dominant coral found on the sandy seagrass zone. The seagrass is intermixed with exposed limestone pavement depressions along the southern end of Yap Island (YCRI Station 13a). The mangrove fringe ceases roughly 100 meters (333 feet) landward of Garim Island where a raised reef flat platform becomes dominant. Close to the island, the reef platform is very shallow and exposed during low tides. Corals are considered an inconspicuous component of the ecosystem with coverage less than 1 percent. In addition to small Porites lutea microatolls, other coral species observed, although infrequently are Porites lobata, Cyphastrea microphthalma, Favia pallida, and Leptastrea purpurea. Once again, the tidal condition restricts coral growth to massive and encrusting species. Similarly, small boat passage is restricted to several hours bracketing either side of high tide due to shallow water depths.

**Enclosed Lagoon Holes (Makef)**

The corals represented in this habitat are similar to those of other enclosed lagoon holes. Coral cover averages 50 percent on the reef margin and slope. A diverse coral assemblage forms an interconnected framework which fringes the hole, and grows up to low tide level. The genera Porites is dominant and the most diverse with P. (S.) rus, and P. lutea being the most abundant species. Common corals include the solitary mushroom coral (Fungia fungites), massive and encrusting species of Favia and Favites, as well as fire coral (Millepora). Unlike in other enclosed lagoon holes, Acropora is not a prominent genus.

The lagoon hole slope is gently terraced and blanketed with live corals with various growth forms. Portions of the reef hole are covered with thickets of staghorn Acropora acuminata and are interspersed with massive hummocky heads of Porites lichen. Also considered abundant are the delicately branched lace coral, Pocillopora damicornis and ramose Porites cylindrica. Encrusting plates of Montipora, small hemispherical heads of Goniastrea and solitary Fungia (V.) concinna, and F. (D.) danai commonly contribute to the slope's complexity. At the bottom, sand deposits dominate with little or no coral coverage.

**Inner Embayment**

The inner portions of Qeetuum Channel is often steep-sided, but also has considerable topographic relief. Along the inward extension of Gabaeh Channel, closest to the village of Ngoof, the channel has a gently terraced relief which descends to a soft silt floor at about 9 meters (30 feet). Massive Porites and P. cylindrica dominate the reef crest and upper 3 meters (10 feet) of the lagoon slope. Dominating the lower lagoon slope to the soft bottom at about 12-15 meters (40-50 feet) is Alveopora. Other species such as Acropora spp., Fungia fungites, and F. echinata are locally abundant while Seriatopora, Pachyseris and Leptoria species are common [109].

The channel wall descends steeply to the lagoon floor at the southern side of Gabaeh Channel, at the entrance's first fork. Overall coral coverage is moderate averaging 50 percent on most of the slope. A narrow coral band 2-3 meters (6-10 feet) wide fringes the channel margin with 60 percent coverage. Just seaward, the coverage diminished to 0 percent on the sandy reef flat which extends out to the ocean reef margin. This solid framework 1 meter (3 1/2 feet) high, creates a complex arrangement of coral colonies including ramose, foliaceous, hemispherical, and discoid forms, which spread horizontally rather than vertically. Most abundant are hemispherical forms such as Favites, Porites, and Favia. Other corals encountered commonly are branching Acropora, hummocky Pavona, and discoid Fungia species. Large, abundant stands of fire coral (Millepora dichotoma) cling to the sandy reef slope with encrusting plates of Merulina ampliata also occurring commonly. Scattered about locally are single species congregations of mushroom corals (Fungia (V.) concinna, and F. (C.) echinata). Further down slope, foliaceous whorls of Montipora foliosa are abundant as are Physogyra lichtensteini colonies. Also present, but less commonly observed are encrusting Diploastrea, Cyphastrea, and Tubastraea coccinea underneath ledges and overhangs.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Depending upon the outer reef flat location, a diverse community is found at the margin which ranges between 5 to 20 percent coral cover (YCRI Station 14a). Overall cover is considered low averaging 5 percent, but is higher on hard surfaces (20 percent). Heads of Porites lutea, thickets of staghorn Acropora, thickly branched A. palifera, ramose Hydnophora microconos, and branching Millepora dichotoma are abundant. Other common corals are Montipora, Goniastrea, Cyphastrea, Leptoria, Heliopora, and

Stylophora.

The southern most end of Yap has a reef flat platform which extends offshore 3500 meters (2.2 miles). Fine white sand generally covers the reef platform out to the seaward margin where consolidated reef rock and calcareous algae predominate. Scattered elsewhere are live coral patches with varying relief, with the assemblages expanding horizontally rather than vertically due to shallow depths. As in most reef flat areas, massive Porites lobata species are dominant with corymbose Acropora being less abundant. Large associations of discoid Fungia are locally common as are Platygyra and Favites species.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The windward ocean reef descends stepwise to deeper depths and features wide terraces with many interesting coral formations. These reef terrace's simulate a flat plain or terrace with a slope of less than 5 degrees. Overall coral cover is high, ranging between 60 to 75 percent, except in numerous large sand depressions. On these sandy areas, there is a preponderance of solitary Fungia and bowl-like colonies of Sandalolitha robusta. A highly diverse coral assemblage blankets both the shallow spur and groove system and the deeper terraces. The dominant genus is Acropora featuring many growth forms such as staghorn, branching, and table forms. Several huge hemispheres of faviid and Porites lobata corals also grace each terrace. While columnar colonies of Porites (S.) rus provide irregular relief 1-3 meters (3-10 feet) high. The organ pipe coral (Tubipora musica) has a patchy distribution throughout the reef slope as does fire coral (Millepora). At the bottom of the buttresses, the staghorn coral Acropora formosa is common while table corals are ubiquitous on the tops.

## OTHER INVERTEBRATES

### Fringing Reef

**Reef Flat**

Reef flats in Ruul (YCRI Station 12a) provide habitat for several sponge species. A black sponge has the greatest distribution but occurs only as scattered individuals. An encrusting brown species can be found here, but it is not common. A brown finger sponge and testillid sp. 1 are present, but rare.

The Gilmaan reef flats are occupied by relatively few macroinvertebrates (YCRI Stations 13a, 14a). Seagrass meadows support three species of sponges. A brown sponge is abundant among the seagrasses. A branching green sponge resembling Clathria cervicornis and a black species are scattered on the substrate among the seagrasses. The orange species Styloterra aginata is scattered among reef rocks on the outer reef flat.

Soft corals constitute the cnidarian macroinvertebrates of the Ruul reef flat. Sinularia spp. are abundant and widespread. Scattered individuals of Lobophytum spp. and Sarcophyton sp. may be encountered in this habitat. The large anemone Stichodactyla gigantea is found in limestone depressions of the inner Gilmaan reef flat.

Epibenthic polychaetes are represented by the feather-duster Sabellastarte sanctijosephi. These tube-dwelling worms occupy limestone rocks on the reef flat.

Few gastropods are conspicuous on the reef flat. The sessile vermetid Dendropoma maxima is common on reef rocks and coral heads. The common spider conch Lambis lambis is present, but rare. The coral-boring scallop Pedum spondyloideum is found embedded in Porites coral colonies scattered on the reef flat. The giant clams Tridacna maxima and Hippopus hippopus are present, but rare. Two Octopus sp. were observed in crevices in coral heads. Seagrasses on the inner Gilmaan reef flat are occupied by the gold-ringed cowrie Cypraea annulus and the money cowrie Cypraea moneta.

Numerous openings of burrows of the infaunal shrimp Thalassina sp. occur on the inner reef flat. These burrows are found in soft substrates of the seagrasses and in coarse rubble substrates overlying limestone.

Recesses in limestone of the inner reef flat provide habitat for the ophiuroid Ophiocoma sp. Occasional individuals can be observed with their arms extending from their refuges.

Echinoderms are conspicuous, but no species is common on the reef flat. The sea cucumbers Bohadschia argus and Holothuria edulis may be encountered on soft substrates. The seastars Culcita novaeguineae and Linckia multifora are present, but rarely observed.

The didemnid ascidian Didemnum molle inhabits the outer reef flat. These zoochlorellae-associated tunicates are scattered on reef rocks and dead corals.

**Enclosed Lagoon Holes (Makef)**

The upper reef slope of an enclosed lagoon hole (YCRI Station 12b) supports several species of sponges. A black finger sponge, a black sponge, and the orange sponge Styloterra aginata are scattered on the upper slope. Two testillid sponges, cf. Cinachyra sp. and testillid sp. 1, are present, but rare in recesses under coral ledges.

Few cnidarians other than scleractinian corals are present in the lagoon holes of Ruul. Soft corals of the genus Sinularia are abundant on hard substrates along the upper slope.

Dead corals on the upper slope provide habitat for the feather-duster worm Sabellastarte sanctijosephi. These polychaetes are scattered in this zone.

Gastropods are the only conspicuous molluscs of the lagoon holes. The sessile vermetid Dendropoma maxima is abundant in coral heads, and the common spider conch Lambis lambis is scattered on the upper slope.

Echinoderms are rare in the enclosed lagoon holes of Ruul. A single individual of the seastar Linckia multifora was observed on the upper reef slope.

**Reef Islet**

Crevices and depressions in the substrate surrounding an uplifted limestone islet are occupied by the anemone Stichodactyla gigantea (YCRI Station 13a). These anemones are common subtidally.

Intertidal surfaces of this islet are heavily encrusted with small vermetids. This species has black, epibenthic shells resembling those of Dendropoma gregaria from other islands of Micronesia. The muricid snail Thais aculeata also inhabits this zone and possibly is a predator on the vermetids. A small Hippopus hippopus was observed in a depression next to the islet.

A grapsid crab, probably Grapsus tenuicrustatus, occupies the intertidal zone of the islet. These crabs are common in wave-washed crevices.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

The soft coral Xenia sp. is abundant on the outer Gilmaan reef flat among scattered coral heads, and Stereonephthya spp. can also be observed in this habitat.

Reef rocks on the outer reef flat provide habitat for the feather-duster worm Sabellastarte sanctijosephi. These polychaete annelids are present, but rarely encountered in this habitat.

The sessile vermetid Dendropoma maxima is abundant in Porites and Millepora coral colonies on the outer reef flat. Giant clams are also dwellers of the outer reef flat. Tridacna maxima is common; Tridacna squamosa and Hippopus hippopus are present, but rarely encountered.

**Reef Margin**

The reef margin is characterized by relatively low diversity, but high numbers of macrobenthos. Sponges are scattered in the reef margin. An encrusting brown sponge and the orange sponge Styloterra aginata may be found here.

Soft corals are abundant in the reef margin. Sinularia spp. and Lobophytum spp. are present in large numbers, and occasional individuals of Sarcophyton sp. may be encountered in the reef margin.

Sabellastarte sanctijosephi, the feather-duster worm, is common in the reef margin. These polychaetes inhabit reef rocks and coral colonies in this zone.

The sessile vermetid Dendropoma maxima is widespread and common in the reef margin. These gastropods inhabit tube-like shells they form on colonies of massive corals. This habitat is shared with the coral-boring scallop Pedum spondyloideum, which is found on scattered poritid colonies.

The seastar Linckia multifora was the only echinoderm observed in the reef margin. This species is present but rare in this habitat. The seastar Culcita novaeguineae is present among coral colonies of the outer reef flat, but it is rarely encountered.

**Gabaeh Channel**

Sponges are the predominant macroinvertebrates of channels in Ruul (YCRI Stations 11a, 12a). Closest to the landward extension of Gabaeh Channel (YCRI Station 12a), fewer species and lower densities of sponges are supported. Individuals of a gray species, Styloterra aginata, and two testillid species are scattered on the slope of the channel at its landward end. In contrast, seven species of poriferans are found in abundance along the channel slope toward its seaward end. The upper slope provides habitat for large numbers of testillid sp. 1, a second testillid, cf. Cinachyra sp., and a branching orange sponge are common here. An encrusting brown sponge, a black

sponge,and the orange sponge Styloterra aginata are abundant on the middle-to-upper slope of the channel. A gray finger sponge is abundant at 12 m depth.

The channel slope provides habitat for the wire coral Cirrhipathes sp. These antipatharian corals are common to locally abundant on limestone outcrops. Their greatest numbers occur at 12 meter (40 feet) depth.

The feather-duster worm Sabellastarte sanctijosephi occupies reef rock on the upper slope of the channel. These polychaetes are common in this habitat.

Molluscs do not constitute a major faunal element of the channel. Only the bear-claw oyster Hyotissa hyotis is common in this habitat. Scattered individuals of the nudibranch Chelidonura amoena may be encountered. The tiger cowrie Cypraea tigris and the cockscomb oyster Lopha cristagalli are present, but rare.

Few echinoderms occupy the slopes of the channel. The seastars Linckia multifora and Acanthaster planci are scattered on the upper slope. The red seastar Echinaster leuzonicus is present, but rare. The sea cucumber Bohadschia graeffei occupies a living coral substrate, where it removes a detritus-laden film from the surface of the coral colony.

The landward end of the channel supports an abundant population of a tan-colored colonial ascidian resembling Symplegma species. These ascidians form encrusting mats on limestone substrates.

### Ocean Reef Slope (Waru 'e naa')

The fore reef community of Ruul and Gilmaan (YCRI Stations 11,12,13,14) supports few macroinvertebrates other than scleractinian corals. A black sponge and a red sponge were the only poriferan species encountered, and they were rarely observed.

Cnidarian macroinvertebrates are represented on the fore reef slope by the orders Stolonifera and Alcyonacea. The stoloniferan Clavularia sp. and the soft corals Lobophytum spp. and Sarcophyton sp. can be found here in low numbers, but in widely dispersed areas of the fore reef slope. Sinularia spp. are present, but they occur in small numbers. The clownfish anemone Heteractis magnifica can be found on the upper slope.

The commercial topshell Trochus niloticus is the only conspicuous mollusc of the fore reef community in Ruul. These large gastropods are present on limestone substrate on the ocean terrace.

An Octopus sp. was encountered on the fore reef slope. This individual occupied a hole in the upper slope.

The large sea cucumbers Stichopus variegatus and Thelenota ananas can be found on mixed sand and rubble of the ocean terrace. The latter species is one of the highly

valued beche-de-mer species, while the potential commercial value of the former has not been ascertained.

Echinoderms are the most diverse macroinvertebrate group of the fore reef community. However, no species was common. One species of crinoid, one species of ophiuroid, three species of asteroids, and one species of echinoid were observed.

Section 5

## FISHES

### Fringing Reef

#### Mangrove Forest (Malil)

A mangrove forest fringes most of the coastline of Section 5, although it is virtually absent at the southern windward tip of Gilmaan municipality. Similar to other mangrove forests, they provide habitats for larval and post-larval forms of fish species. During the YCRI survey, no mangrove stations were observed. It is likely, however, that the faunal assemblage will reflect those of other mangrove stations.

#### Reef Flat

The inner reef flat between the mangroves and Gabaeh and Changad Channels is blanketed primarily by seagrasses. Coral colonies are uncommon here, but become more noticeable at the landward margin of the channel. Interspersed among the coral heads and sand patches are numerous juveniles of the families Chaetodontidae (butterfly fish), Acanthuridae (surgeon fish), Labridae (wrasses), Scaridae (parrot fish) and Apogonidae (cardinal fish). Along the channel slopes the diversity increases to include 13 families. A variety of parrot fishes, surgeon fishes and squirrel fishes occur.

#### Inner Channel

The inner channel wall possesses a relatively diverse fish fauna increasing by five fish families (YCRI Station 11a) compared with (YCRI Station 12a). Along the seaward coral rimmed margin, fish families dominating include Chaetodontidae (butterfly fish), Labridae (wrasses), and Pomacentridae (damsel fish). A total of 21 butterfly fish species were observed followed by 14 wrasse and 12 damsel fish species. Aggregations of Monotaxis grandoculis (emperor bream) and fusiliers (Caesio spp.) migrated along the channel walls. Elsewhere, more localized assemblages of Dascyllus aruanus and D. reticulatus (damsel fishes) darted among the branching coral fingers. Small groups of parrot fishes (Scarus gibbus, S. sordidus and juvenile Scarus spp) foraged on the corals and algae. Several goat fish (Mulloides flavolineatus, Parupeneus spp.) schools migrated close to the sand/silt channel bottom. Elsewhere, solitary cryptic individuals such as gobies perched on corals.

#### Enclosed Lagoon Holes (Makef)

These lagoon holes continue to possess a relatively diverse fish assemblage. Wrasses (Labridae) are the most diverse family present with 19 species, followed by damsel

fishes with 12 and butterfly fishes with 9 species. Three damsel fish species are most numerous overall; these are the blue-green and white striped damsel fishes (Chromis viridis, Dascyllus aruanus), and the aggressive black damsel fishes (Stegastes nigricans). Juvenile parrot fishes (Scarus spp.) school along the reef with many individuals, while goat fishes (Mulloides vanicolensis and Parupeneus multifasciatus) move throughout the interconnecting network of sand patches. Monocle breams (Scolopsis lineatus) hover in groups over the reef as do some snapper (Lutjanus fulvus, L. gibbus, L. monostigmus) and emperor fishes (Gnathodentex aureolineatus, Monotaxis grandoculis) species. Numerous pipe fish (Corythoichthys intestinalis) curl among the coral heads.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

Seaward, on the ocean reef terrace the diversity of the fish community increases with depth. A total of 25 fish families were observed representing 108 species. Closest to the entrance of Qeetuun Channel, several territorial gray reef sharks (Carcharhinus amblyrhynchos) were encountered while a single black tip (C. melanopterus) and white tip (Triaenodon obesus) cruised unobtrusively through the survey region. A large school (16 individuals) of the big-eye jack (Caranx sexfasciatus) and fusiliers (Pterocaesio tile, Caesio teres) were also observed during YCRI stations 11 & 12. Other large species observed occurring both singly and in small groups were emperor breams (Monotaxis grandoculis), and goat fishes (Parupeneus bifasciatus, P. cyclostomus). Hidden under ledges resting are bronze sweepers (Pempheris oualensis) and squirrel fishes (Myripristis spp.) awaiting darkness. The only observation of a barracuda (Sphyraena barracuda) occurred at YCRI Station 11 hovering in midwater.

## OTHER MARINE VERTEBRATES

Green sea turtles (Chelonia mydas) are known to inhabit the ocean and lagoon waters of this Section. Although no turtles were observed here during the YCRI survey, local informants stated that turtles are seen feeding and resting on the seagrass beds off Ruul. Furthermore, the turtles are known to migrate through the Gabach Channel and Tamil embayment on the northeastern reef flat. An unidentified pod of porpoises or dolphins were observed offshore several times during several days near the vicinity of YCRI Stations 12, 13, and 14.

## ARCHAEOLOGICAL AND HISTORICAL SITES

The dominant villages in the alliances of this region of Yap were Guroor and Qanooth in Gilmaan, who were next in power under the Ngolog/Baleabaat village pair. Importantly, Guroor village was the dominant village of the alliance network that extended west to Ngulu Atoll [59,107].

Archaeological survey is limited in this region. Considerable survey work did take place in the savanna areas of Yinuuf, Luweech, Lamear, and Dariikaan villages before the construction of the new airport. This work included reconnaissance surveys [15,28,66,68,92], detailed surveys and excavations [91], and important, accompanying social anthropological studies which recorded oral histories [91]. These savanna areas contained major burial and ditch-bed garden complexes. Some coastal sites were identified [68]. Additionally, a reconnaissance survey was done recently in the small, inland serf village of Wugeem [59].

In Gilmaan, only one survey of village settlement patterns has occurred -- a brief reconnaissance in Gachalaaw village [59]. A few sites -- surface middens (piles of discarded shell food remains and artifacts) -- were located in Guroor and Qanooth and underwent limited excavation [42,57,58,107]. Two of these sites -- Pemrang in Guroor and Rungruw in Qanooth -- yielded early pottery types and the earliest dates for Yap, so far, dating back to about B.C. 300s and A.D. 0-100, respectively [107,59].

Coastal sites abound in this region and include fishtraps, faeluw, and reclaimed taro areas. None have been well documented archaeologically. With extremely early sites in this area of Yap, archaeological inventory of these sites are critical. Prior to any development at these sites, important archaeological data should be recovered and preserved.

Section 5

## RESOURCE USES

### Terrestrial

This Section has some potential for resort and tourism development. The southern coastline of Gilmaan Municipality is relatively flat and has a number of small beaches. One beach area north of Guroor village has been recommended for improvement as a public beach park suitable for residents and tourist [26]. Additionally, there are several historical sites which could be improved and promoted as tourist attractions. A World War II Japanese landing strip complete with several Japanese fighter planes and defense emplacements are located in Ruul municipality. Japanese shoreline defenses can be seen along the shoreline. If these areas were revitalized and maintained, they could be incorporated into a tour package featuring points of interest in southern Yap Island. Access to this Section, however, is by an unimproved secondary road which is not slated for improvement in the near future [123]. Caution is also advised to potential swimming, snorkeling, and diving activities centered near the southern reef flat extension off Gilmaan due to strong and hazardous current conditions.

### Fringing Reef

Interviews with fishermen from throughout southern Ruul and Gilmaan municipalities provided the following fisheries information for this Section (Appendix F).

#### Mangrove Forest (Malil)

With the exception of the southern tip of Gilmaan, a continuous mangrove belt lines the entire coastline of Section 5. The mangrove serves as a lush habitat for mangrove crabs (*qamaang*) and the land crabs (*galip*) which are found in abundance. Additionally, the swimming crab (*qurich*) is found in the same area and along the shoreline down the tip of Gilmaan municipality. Schools of flagtails (*faakeayaan'*, *liyeq*) also swim along the perimeter of the mangrove forest and could be used as tuna bait fishes. Mullet (*quloch*, *galaed*) are plentiful in the mangrove areas also, especially during high tide when they are caught using gill nets.

Mangrove hardwood is used by residents as a source of building material. Because the mangrove is so extensive, a small scale commercial logging industry may be feasible. However, the forest's sustainable yield should be determined prior to allowing commercial activities.

**Reef Flat**

The inshore areas are reported to be very productive with many men fishing this area. Sea cucumbers (*l'ugul*) are plentiful, but are not harvested. If the populations of commercially valuable species are available, a small export industry could be developed in the future. Rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*) are sometimes caught with a throw net in the seagrass areas. Other fish species harvested are goat fishes (*manguch, mbing, soong*), emperor fishes (*wul, qoeyeq, gadgad*), and milk fishes (*guuguw, tangir*). These fish are considered to be abundant and typically harvested by gill net. Trochus (*yogyog*) is also commercially harvested in this area. Historically, turtles have been captured throughout the reef flat, but are rarely seen today. The best time of the year for capture are May and June.

Two previous dredge sites located offshore of Ngoof and Magachagil villages were examined to determine the feasibility of using reopening the dredge site [105]. The Ngoof site could be used again for construction material for future project with certain precautions according to this report. No recommendation was made for the other site.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Fishermen reported capturing many fish species on the outer reef flat. Intermixed with the coral patches are good populations of parrot fishes (*qelbad, qalaabal, malngoed)*, surgeon fishes (*quum, maath, machagwog, bilaew*), rudder fishes (*guumiy*), angel fishes (*qeer, buloch*) and trigger fishes (*wuuq, moelngith, nguuf*). These fish were reported to be particularly plentiful near Gilmaan which are harvested by gill nets and spear fishing. Emperor breams (*qutun*) are also found along the reef, but are harvested by handline or spear fishing.

**Gabaeh Channel**

Snappers (*gooychaaf, gadaw*) are found along the channel margin and slope of Gabaeh Channel. Fishermen report harvesting them by hand line and spear fishing. Jacks (*ngool, muul, qelqel*) are also caught the channel by using a handline or by spear fishing. Squirrel fishes (*yooch*), parrot fishes, and surgeon fishes also transverse the reef slope and channel edges. They are harvested using gill nets and by spear fishing.

Section 5

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The ocean reef fisheries are abundant and diverse. Fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*machagwog, maath, bilaew*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), and goat fishes (*manguch, mbing, soong*). Spear fishing is the preferred fishing method, with groupers (*smaak'uw, k'uw*) being caught with a handline. Groupers are not considered to be very abundant. Snappers (*gooychaaf*) are caught on a handline at the reef edge. Jacks (*ngool, muul, qelqel*) are caught seaward of the reef using a hand line or by spear fishing.

Barracuda (*qanger, maal*) and rainbow runner (*thilbuw, foofow)* are found seaward of the ocean slope, but close to the edge and are caught infrequently as a by-catch while trolling for tuna. Other species also caught trolling, but farther offshore are tuna (*taguw)*, wahoo (*malchath)*, and dolphin fishes (*dabaar*). As in other sections, these species are not fished heavily. Dogtooth tuna (*yasul*) are caught near the entrance to Qeetuun Channel by trolling. Flying fishes (*goeg*) are found along these waters and are caught at night using a lantern to attract the fishes and scoop net to snare them. They are also caught during the day using the scoop net. Rainbow runner have been spotted and caught as far as five miles from the reef near the fish aggregating device (FAD) located south of Gilmaan.

Topshell or Trochus (*yogyog*) is harvested for commercial purposes along the reef's edge. Clams (*faasuw, tow*) are also found along the barrier reef's edge. Turtles are captured along the barrier reef and in the reef flat but are rarely seen in recent years. The best time of the year for capture are May and June.

## WATER QUALITY

Point source discharges were reported for Ruul from the high school into the bay between Meer and Beenik and from an agriculture waste water and septic tank discharge into the same area. No other point sources were found in any part of this Section [30]. Non point sources were similar to those reported in Section 2.

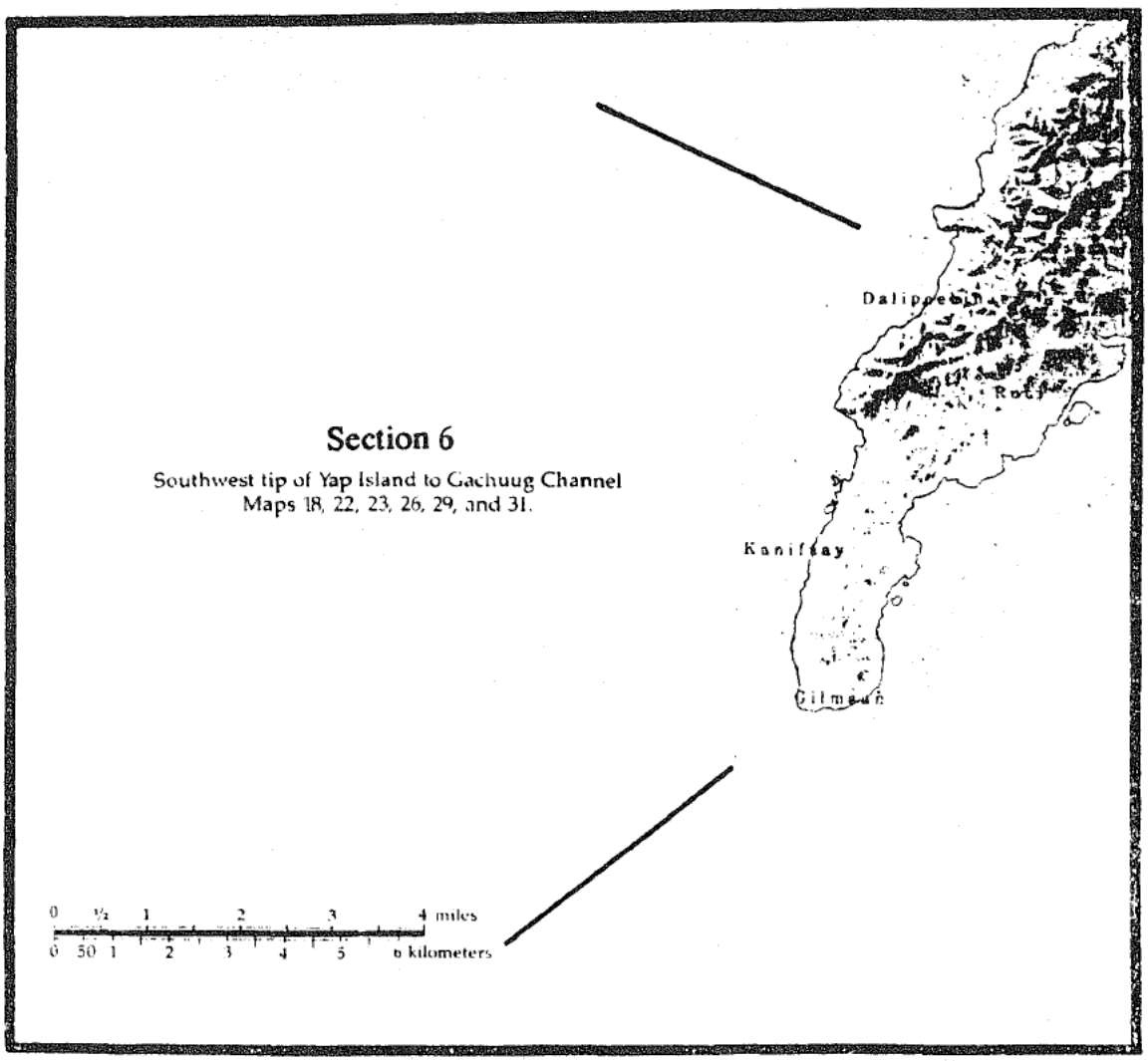
The waters from Ruul south to Guroor village in Gilmaan are classified as AA. From Guroor village south and around the southern tip of the island to the vicinity of Thabeeth village, the waters are classified as A because of the development potential of several beaches in this area as public recreational areas. One station was surveyed in this section and all parameters were within the levels specified in the standard [18]. Two previously used dredge sites are within this section. Neither is in use but reopening either site for dredging may have an impact on water quality. Mitigative measures should be taken to decrease the short term impacts resulting from dredging.

## SECTION 6: WESTERN GILMAAN, KANIFAAY, & DALIPEEBINAEW

### GENERAL DESCRIPTION

This Section begins at Yap's southernmost reef point and extends north along the leeward coastline to Gachuug Entrance, also part of Yap Island (Figure 10). The leeward coastlines of three Municipalities comprise this region and are Gilmaan, Kanifaay, and Dalipeebinaew. Several larger village settlements lie adjacent to the coastline and mangrove forests.

**FIGURE 10. A MAP OF SECTION 6 WHICH INCLUDES THE AREAS OF WESTERN GILMAAN, KANIFAAY, & DALIPEEBINAEW.**



## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

Section 6 extends from the most southwestern reef tip of Yap Island and north along the leeward (western) coastline to Tageegiin village which lies on the shoreline fronting Gachuug Channel. The southern plateau or coastal plain forms the southern portion of this island with steep shoreline escarpments 5-8 meters (16-26 feet) high. The coastline is generally marshy throughout the year; the largest marsh area lies between Taafniith and Faraq [36,104]. A narrow mangrove forest band fringes the shoreline of the plateau.

Further north, the central low hills rise between 40-100 meters (133-333 feet) in elevation. The western hills slope gently, but become steep at the coast ending in cliffs 5-10 meters high (20-30 feet). Both the coastal flats and mangrove forests are narrow and discontinuous. Several streams and tributaries drain into the coastal region adjacent to Gachuug Channel.

### Fringing Reef

The fringing reef extends offshore showing variable widths in Section 6, with a maximum width of 3.5 kilometers (2.2 miles). The shallow reef flat extends 3 kilometers (1.8 miles) beyond the southern land boundary of Yap island and 3.5 kilometers (2.2 miles) north, and is devoid of any enclosed lagoon holes. Further north along the west coast, the reef platform is punctuated by fourteen (14) enclosed lagoon holes of various sizes and shapes. Delimiting the northern boundary of this Section (and the southern boundary of Section 7) is Gachuug Channel and embayment.

#### Mangrove Forest (Malil)

Much of the nearshore fringing reef is occupied by a narrow zone of mangrove forest. Several offshore mangrove stands occur west of Neel village while the densest stand lies just south of Tageegiin village. The forest belt is cleared at numerous places for small boat passages.

#### Reef Flat

The nearshore fringing reef flat commences with an unvegetated band of silt and sand, only a few meters wide, closest to the outer margin of the mangrove forest. Further seaward towards the lagoon, this zone is replaced by a mixed zone of seagrasses and

microatolls. The seagrass continues to grow amongst sand and hard reef rock with the proportion of silt and seagrass decreasing with increasing distance from shore. On the other hand, sand and live coral patches, mounds and thickets become increasingly more abundant in a seaward direction. At the southern end of the reef platform, this trend continues with the presence of robust coral species able to withstand the high wave energy environment of the reef margin, enlarging horizontally (YCRI Station 14a).

Dense coral colonies interspersed with sand patches connect the margin of the leeward enclosed lagoon hole network. The back reef supports a moderately high abundance of coral species whose growth forms extend horizontally rather than vertically due to the shallow water depths (1-3 meters )(3-10 feet). Closer to the outer reef margin, the reef corals encounter shallower, and calmer waters. Hence, the abundance of lobate, encrusting, and corymbose species increases significantly. A veneer of pink coralline algae and surge rills etched in the platform are commonly observed. Fragment of reef rubble, probably thrown up from the ocean fore reef during a previous episode of high waves, dot the leeward reef's southernmost point.

**Enclosed Lagoon Holes (Makef)**

The northern leeward reef flat is punctuated with fourteen enclosed lagoon holes in Section 6. Their close proximity to one another allows for interconnecting coral thickets and patches between holes. Additionally, their sizes range from 200-600 meters in diameter with no uniform configuration amongst all. YCRI Stations 15a and 16a documents the general geomorphology of this Section's holes as described below.

Live coral development nearly completely rings the enclosed lagoon margin and adjoining reef flat. Prominent species include massive, branching, and corymbose forms interwoven together with the elevated tips of the outer-most corals dead due to daily tidal exposure. Substrate relief is minimal with these complex colonies extending laterally rather than vertically.

The upper edge of the reef hole slope typically exhibited moderate to high coral coverage (75 percent) and diversity while the isolated coral heads comprised the only relief on the deeper talus slopes. An irregular mass of live corals, overhanging in some spots, composes the upper zone. While in other areas, slumped coral blocks had removed stretches of live coral leaving only a coral rubble and sand shelf at 3-4 meter (10-13 feet) depths. Closest to the sand bottom, coral thickets were precariously balanced on the soft slope. As with other enclosed lagoon holes, sand and rubble are the major bottom substrate component.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

The reef flat platform extends to the outer reef crest and consists of several distinct zones as in other areas. Along the back reef margin, extensive tracts of low microatolls, massive and corymbose coral species begin to dwindle seaward. These are replaced with wider expanses of solid eroded reef rock, slight depressions with sand and rubble, and fewer live corals. Closest to the outer reef flat margin, coralline algae becomes a conspicuous component among the uniformly flat pavement. Slight surge channels bisect the reef crest leading to greater depths in a seaward direction.

## Ocean Reef Slope (Waru 'e naa')

**Ocean Slope**

The ocean slope of Section 6 exhibits unusual, interesting and typical leeward ocean slope features (YCRI Stations 14,15,). At the southernmost reef extension of Yap Island, the ocean slope is dominated by living reef corals at all depths (100 percent coverage). At shallower depths (6-10 meters )(20-33 feet), broad buttresses and small grooves or channels open out into tremendous canyons or reentrants with wide flat floors at depths of 10 meters (33 feet) paved with massive, smooth and rounded dead coral rocks. Seaward, very irregular terracing with prominent and projecting coral relief, sometimes towering several meters in height, slopes descends steeply to greater depths.

Further north, the shallow reef slope descends gradually to 13 meters (40 feet) below which the slope steepens. Along the shallower depths (>6 meters or 20 feet), coralline algae are a conspicuous substrate component and live coral coverage averages 35 percent. A nearly vertical drop off occurs at 20 meters (60 feet), with a deep terrace reported at roughly 60-65 meters (180-200 feet). Along this face, both massive, columnar, and plate coral species grow horizontally out from the wall. Between 10-20 meters (30-60 feet) coral coverage and abundance is greatest at 50-60 percent, while it decreases to 35-50 percent along the deeper wall faces. Coral coverage within diving range averages about 50 percent.

**Reef Passes (Dubchol)**

There is only one ocean reef passes in Section 6 and it is called Gachuug Channel. Its entrance passage is very narrow, averaging 200 meters (666 feet) in width, which opens up into an irregularly shaped embayment with two named bays: Guchuth and Boen.

**Section 6**

Several peninsular reef flat extensions penetrate the embayment.

Stout microatolls and hard current and wave resistant reef rock pavement, fortify the margin of both channels. The narrow channel entrances generally shoals landward to about 5 meters (15 feet) before terminating as the steep, vertical walls of the inner embayment. Little coral colonizes these outside walls other than encrusting forms which veneer the wall leading into the embayment. Lush coral coverage was observed, however, in several of the more protected, backwater areas of the channel.

## FLORA

### Fringing Reef

**Mangrove Forest (Malil)**

Much of the nearshore fringing reef is occupied by a narrow zone of mangrove forest. Several offshore mangrove stands occur west of Neel village while the densest stand lies just south of Tageegiin village. The forest belt is cut at numerous places for small boat passages.

**Reef Flat**

Adjacent to the mangrove forests, a narrow channel several meters wide and devoid of seagrasses is found. A zone of mixed seagrasses predominated along the coastline including the species Enhalus acoroides, Thalassia hemprichii and Cymodocea rotundata. The red alga Gracilaria salicornia was the most abundant algae with 30 percent cover. Other species present, but considered rare are Gracilaria sp., Caulerpa racemosa, C. cupressoides, Halimeda macroloba, and H. incrassata.

**Enclosed Lagoon Holes (Makef)**

The dominant algae reported by Hedlund and Tsuda [45] in the western lagoon holes were Polysiphonia spp. with the green alga Halimeda gigas forming dense patches among coral heads on some holes. Other species forming scattered stands among the corals included the green alga H. opuntia, the blue-green alga Microcoleus lyngbyaceus, and the brown algae Lobophora variegata, Padina tenius, and Turbinaria ornata.

**Seaward Reef Flat**

The outer pavement including the coral shingle thrown up from the ocean reef,is typically veneered with calcareous red algae. In small current rills, more rigid alga such as Turbinaria ornata is found along with some Padina spp. Frequently, an algal turf colonizes some of these small reef depressions.

### Ocean Reef Slope (Waru 'e naa')

**Ocean Slope**

Crustose coralline algae occur commonly on the shallow wave inundated ocean reef slope. Below 10 meters (30 feet), the ocean reef slope is heavily dominated by live corals and readily observable macroalgae were not found during the YCRI survey.

Section 6

## CORALS

### Fringing Reef

**Reef Flat**

Little or no coral is found on the sediment and seagrass dominated reef flat fringing this Section. The inshore areas have only 0 to 1 percent coral cover, which generally increases to 5 to 10 percent farther from shore. Low Porites microatolls comprise most of this cover. Depending upon the locality, small heads of Favites, Pavona, and Pocillopora may also be found. Overall, the coral cover increases up to 35 percent at the margin of the reef holes.

**Enclosed Lagoon Holes (Makef)**

The enclosed lagoon holes are nearly or completely ringed with corals around the upper reef margins. Moderate coral cover ranging between 35 to 50 percent blankets most of the upper reef slope, with the lower, sandy slopes devoid of most corals. Porites represents the most diverse genera with six species encountered. Other predominant species located along the reef margin are Cyphastrea microphthalma and Montipora foliosa . Further down slope, heads of Porites australiensis, P. lutea, fire coral (Millepora exesa) and stands of branching Porites cylindrica are abundant. Perched along the sand slopes are thickets of yellow arborescent Acropora acuminata which are locally abundant.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

The outer reef flat community along the leeward side of Yap Island is a solid surface of reef rock and fine sand. Shallow depths (1-2 meters [3-7 feet]) dominant with localized coral assemblages scattered across the back reef. In these areas, coral cover ranges between 5 to 10 percent and to less than one percent elsewhere. Sturdy coral growth forms predominate in current swept areas. These include ramose Hydnophora microconos, Porites lutea heads and microatolls, and branching columnar colonies of Acropora palifera and A. cuneata. Further seaward, the reef flat becomes progressively shallower thus replacing horizontal coral growth with vertical colony expansion. More conspicuous growth forms include lobes of Favites and Porites or stout heads of corals such as Acropora nasuta. Along the wave swept platform, the hard rock substrate is littered with sand and rubble thrown up from the ocean fore reef. Seaward, the algal encrusted platform contributes to the reef margin components, but is not as abundant as on the windward side. The reef margin forms a wide, very shallow crest of solid pavement with up

to 1 percent coral coverage which merges with the wave zone. Small surge channels and rills colonized by hardy encrusting corals, are found past the surf line.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The ocean slope in this section transforms from a typically gradually sloping "windward" ocean reef (YCRI Station 14) to a steeply sloping "leeward" reef with a nearly vertical wall (YCRI station 15). Near the southwestern-most end of the island, the reef slope is irregularly terraced and is completely dominated (100 percent) by living corals. Shallower zones show broad buttresses and small grooves covered with coral. These open up into irregular canyons (reentrants) and depressions virtually devoid of corals. Species clinging to the scoured vertical canyon walls include hemispherical heads and encrusting growth forms. Seaward at the base of these canyons, Acropora comprises the dominant genus with plate/branching colonies of A. irregularis being most abundant at 9 meter (30 feet) depths. On the rolling terraces below, a combination of irregular growth forms are present which create an area of highly variable relief. Giant hemispherical corals of Porites and Platygyra, rising 2-3 meters (6-10 feet) in the water column, are situated between whorls and fields of the foliaceous coral Echinophyllia aspera and the staghorn coral Acropora. Commonly intermixed is a variety of other corals including columnar colonies of Porites (S.) rus, partially hidden plates of Galaxea, and Acropora, including both table and arborescent forms. Less conspicuous and found only occasionally are Leptastrea, Symphyllia, Montipora, Favia, Favites, Diploastrea, and Pachyseris.

Along the northwestern-facing portion of the ocean reef slope, a gradually sloping terrace which begins to drop off steeply at an 80 degree angle changes to a nearly vertical wall, close to 30 meters (100 feet) high. The vertical drop begins at a depth of 18 meters (60 feet) and descends to a deeper terrace or shelf at about 54-60 meters (180-200 feet). Above 6 meters (20 feet), coralline algae (Porolithon) is the most conspicuous substrate component. Where coral cover averages between 50 to 60 percent, it is interspersed among consolidated reef rock patches. Further seaward, the percent cover increases with depth. The most abundant coral found along the upper platform are cespitose Acropora florida, the organ pipe coral Tubipora musica, and lobes of Porites lobata. Many other corals are found commonly such as Platygyra, Echinophora, Pachyseris, Favia, Goniastrea, and the soft zoanthid coral Palythoa. Deeper and along the vertical wall, coral cover drops to 50 percent and features mostly encrusting species. Just below the drop off, narrow

ledges with overhanging coral platelets create cave-like habitat for other fauna, particularly fishes.

## OTHER INVERTEBRATES

### Fringing Reef

**Reef Flat**

Reef flats of this section support sponges in both coral and seagrass communities. A branching green sponge resembling Clathria cervicornis and a brown sponge are scattered among the sea grasses. Dysidea herbacea forms encrusting colonies on limestone substrates of coral communities.

Seagrass areas with fine sediments covering the substrate provide habitat for occasional medusae of the benthic scyphozoan Cassiopea medusa. The soft corals Sinularia spp. are common on reef rocks of the coral communities.

The only conspicuous molluscs of reef flats in this sector is the vermitid worm Dendropoma maxima. These sessile gastropods are found on scattered coral heads and reef rocks of coral communities.

Sea cucumbers inhabit both seagrass and coral communities of the reef flat. Stichopus chloronotus and Holothuria atra may be found on soft substrates scattered throughout the coral community, and Holothuria edulis is present but rare. The seagrass meadow support populations of Holothuria atra and Synapta maculata, but neither species is common.

**Enclosed Lagoon Hole**

This enclosed lagoon hole (YCRI Station 15a) lacks the diversity of macroinvertebrates characteristic of other areas of Yap. *Styloterra aginata* is abundant along the upper slope, and an encrusting brown sponge is common.

The feather-duster worm Sabellastarte sanctijosephi occurs on reef rocks of the upper slope. This species is rarely observed here despite an apparent abundance of suitable habitat present.

Bivalves are the only conspicuous molluscs of the lagoon hole. The boring ark Arca ventricosa and the thorny oyster Spondylus squamosus can be found on reef rocks of the upper slope. The black-lipped pearl oyster Pinctada margaritifera is present, but rarely encountered.

Seastars are the only group of echinoderms occurring in the lagoon hole. The cushion star Culcita novaeguineae and the red seastar Echinaster leuzonicus may be found scattered among coral heads of the upper slope.

Ascidians are the predominant macroinvertebrates of this habitat. The dark green tunicate Eudistoma cf. viride is ubiquitous on dead corals and reef rocks from the upper slope to a depth of 12 meters (40 feet). Clusters of these tunicates give the appearance of black caviar. The ascidian Didemnum molle is also abundant to 12 meter (40 feet) depth, but it occurs in less dense aggregations. The tan-colored colonial ascidian Symplegma sp. is abundant on the upper slope, where it forms encrusting mats on reef rocks.

**Ocean Reef Slope (Waru 'e naa')**

Sponges do not comprise a significant part of the fauna of the fore reef community of Kanifaay. Mats of Dysidea herbacea are present but not common. Additional sponges, a black species and a brown species, are rare in this habitat.

Trochacean gastropods and giant clams are the conspicuous molluscs of the fore reef habitat. The turban snail Turbo argyrostomus can be found scattered in crevices of the reef framework of the middle slope area. The lower slope and terrace are occupied by the commercial topshell Trochus niloticus, which is common, and the topshell Tectus pyramis, which is rare. The giant clams Tridacna maxima and Tridacna squamosa inhabit the upper slope.

The boring urchin Echinostrephus cf. aciculatus is abundant in its burrows in oblique surface of limestone of the middle-to-upper slope. Echinometra mathaei is commonly observed in its grooves in limestone pavement of the upper slope. The seastar Linckia multifora can be found here, but it is not common. The seastar Echinaster callosus occupies the 12 meter (40 feet) terrace, where it is rare.

The didemnid ascidian Didemnum molle is an abundant species of the fore reef slope. These tunicates occur on limestone substrates throughout this habitat.

## FISHES

### Fringing Reef

**Mangrove Forest (Malil)**

A narrow, fairly continuous belt of mangrove forest occupies the inner reef flat along the entire coastline of Section 6. Larval and juvenile fishes assembled among the network of mangrove prop roots. These species included cardinal fishes (Apogonidae), snappers (Lutjanidae) and mojarras (Gerres sp.). Although no YCRI mangrove stations were completed, a similar mangrove fauna probably inhabits these forest areas too.

**Reef Flat**

Along the inner reef flat, extensive seagrass beds are exposed or nearly exposed at low tide, and thus limits the diversity of fish fauna.

**Enclosed Lagoon Holes (Makef)**

The fish abundance and diversity is notably higher in the lagoon holes (YCRI 15a) compared to the reef flat. This station exhibited a moderately diverse assemblage of 57 species displayed among 18 fish families. The most varied assemblages are from the families Pomacentridae (damsel fishes) and Labridae (wrasses), exhibiting 10 species each followed by Chaetodontidae (butterfly fishes) with 9 species. Commonly observed species are Ctenochaetus striatus (surgeon fish), Asterropteryx semipunctatus (goby) and several damsel fishes (Abudefduf sexfasciatus, Amblyglyphidodon curacao, and Pomacentrus coelestis). Medium sized parrot fishes schooled throughout the hole (Scarus dimidiatus, S. sordidus) while Mulloides flavolineatus (goat fish) moved in groups along the sandy lagoon hole's bottom. The honey comb grouper Epinephelus merra were seen frequently darting underneath coral heads. Trigger fish (Rhinecanthus aculeatus, Sufflamen chrysoptera) patrolled this territory cautiously, always ready to lock themselves into a reef hole for protection.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Along the seaward margin of the outer reef flat, the flora and faunal populations are restricted to species adapted to wave swept regions. The diversity decreased to 14 families and a total of 60 species. The two dominant families continue to be Labridae (wrasses) and Pomacentridae (damsel fishes). The families Acanthuridae (surgeon fishes) and Chaetodontidae (butterfly fishes) follow respectively in species diversity. The species

assemblage reflects the rough water conditions, with mixed species aggregations of surgeon fishes (Ctenochaetus striatus, Acanthurus nigrofuscus), and parrot fishes (Scarus sordidus, Scarus sp. juveniles). Small groups of goat fishes (Parupeneus barberinus, and P. multifasciatus) traversed the interconnecting sand flats surrounding the coral complexes. Near these complexes, a hump-headed wrasse (Cheilinus undulatus) was usually encountered. Sequestered close to the corals, are small groupers such as Cephalopholis argus and Epinephelus merra. Surge damsel fish (Chrysiptera leucopoma) hovered close to the coral substrate as did Plectroglyphidodon lacrymatus and P. dickii. Small aggregations of the blue-green damsel (Chromis viridis) occurred around branching coral species.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The ocean slope has a highly diverse and rich assemblage of fish species. During YCRI Stations 14 and 15, 22 fish families were observed, which represented 108 species, including the most prominent fish families. An assortment of colorful reef fishes inhabit the reef structure and along the steep walls. Notable among these are butterfly fishes (Chaetodontidae), wrasses (Labridae), and surgeon fishes (Acanthuridae). Hidden among coral terraces and in cracks and ledges along the wall are nocturnal species including cardinal fishes (Apogonidae) and squirrel fishes (Myripristis adustus, M. murdjan, M. violacea, Sargocentron sp.). Along the drop off, locally abundant species included schools of fusiliers (Pterocaesio tile, Caesio teres), emperor breams (Gnathodentex aureolineatus and Monotaxis grandoculis), and trigger fishes (Balistapus undulatus, Melichthys niger, M. vidua). Parrot fishes (Scarus niger, S. longiceps, S. oviceps, S. schlegeli, S. sordidus) appeared more numerous along the upper reef slope. Similarly, small reef fishes such as wrasses and damsel fishes are also found here.

## OTHER MARINE VERTEBRATES

During the YCRI field survey, no green sea turtles were observed on either the reef flat or ocean reef in Section 6. Local fisherman, however, described all seagrass pastures as potential turtle feeding grounds.

Section 6

## ARCHAEOLOGICAL AND HISTORICAL SITES

Neef village seems to have been the powerful village of this area in the mid-1800s.

Archaeological survey work is extremely limited in this region. Reconnaissance surveys took place in parts of the savannas of Faraq, Taafniith, Yabach and Feeduqor and in the coastal areas of Nel as part of the new airport studies [15,28,68]. A brief reconnaissance survey also was done in the housing area of Yabach [59]. These surveys identified ditch-bed agricultural systems and associated burials in the savanna, and typical village sites near the shore. A schist quarry for building stones was found in Yabach [59].

In addition to these studies, some limited excavations took place at a shell midden site (Mab oi) in Nel [59] and at a house site (Boldanig) in Maalay [42,107]. Dates were processed, dating these sites back to less than A.D. 1700 for Mab oi and back to the A.D. 400s for Boldanig [59,107].

As elsewhere on Yap, fishtraps can be seen on the reefs of this area, but they have yet to be recorded archaeologically. Some interesting findings have come from the excavated food remains from Mab oi. Mollusk food remains were consistent over time, with 90+ percent Strombus mutabilis and 4-8 percent Terebralia sulcata -- the former from a seagrass with sand bottom habitat and the latter from the mangroves [59]. No fish remains were found, a pattern claimed to perhaps be consistent with the serf rank of Nel village and restricted access to ocean resources [59].

## RESOURCE USES

Information for this section was primarily obtained from fisherman from Gilmaan, Kanifaay, and Dalipeebinaew municipalities (Appendix F).

### Terrestrial

As mentioned in the previous Section, Gilmaan has many small scenic villages and accessible shorelines with some beaches. Hence, its prospects as a potential tourist destination are high. The northern coastline of this Section, however, does not have any beaches. Rather, at low tide, vast expanses of the seagrass pastures are exposed making water activities difficult. Hence, this Section is not being considered as a high priority for tourism development.

### Fringing Reef

**Mangrove Forest (Malil)**

Much of the nearshore fringing reef is occupied by a narrow zone of mangrove forest. Mullet (*quloch, galaed*) schools are plentiful, especially during high tide. Gill nets are used to harvest these fishes. Because of the relatively sparse mangrove coverage, harvesting should be allowed only for subsistence purposes.

**Reef Flat**

A zone of mixed seagrasses extends seaward onto the mixed sand and coral patches on the reef flat. Fish species caught regularly by gill nets or surround nets are rabbit fishes (*dayit, garmiy, buywod, darruy, limreq)*, goat fishes (*manguch, mbing, soong*), emperor breams (*wul, qoeyeq, gadgad*), and milk fishes (*guuguw, tangir*).

There are no previously used dredge sites in this Section [105], and no future sites are planned. Materials from other sites should be exhausted before any sites in this area are considered.

**Enclosed Lagoon Holes (Makef)**

Angel fishes (*buloch, qeer*), wrasses (*numean)*, parrot fishes, surgeon fishes, and squirrel fishes (*yooch)* are found along the perimeter of the lagoon holes. These species are harvested by using surround nets and spear fishing. Grouper (*smaak'uw, k'uw*) are found in deeper water and are caught by handline or spearfishing. The only incidence of fishermen catching barracuda inside lagoon holes was reported in the Maangyoer and

Gutoer holes. Turtles are seen infrequently in this Section.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Complex coral patches and thickets continue to offer habitats for numerous fish species sought after by fishermen. Some of these species are parrot fishes (*qelbad, qalaabal, malngoed)*, surgeon fishes (*quum, math, machagwog, bilaew*), rudder fishes (*guumiy)*, angel fishes (*qeer, buloch*) and trigger fishes (*wuuq, moelngith, nguuf*). These fishes are harvested by gill net and spear fishing. Emperor breams (*qutun)* are also found along the outer reef flat and are harvested by handline or spear fishing. Near the entrance to Gachuug Channel, snappers (*gooychaaf, gadaw*), surgeon fishes, wrasses, and breams (*qutun)* are caught with nets, spear fishing, and hand lines.

**Ocean Reef Slope (Waru 'e naa')**

**Ocean Slope**

The ocean reef fisheries are abundant and diverse. Fishermen report catching parrot fishes (*qelbad, qalaabal, malngoed)*, surgeon fishes (*machagwog, maath, bilaew*), rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), and goat fishes (*manguch, mbing, soong*). Spear fishing is the preferred fishing method, with groupers (*smaak'uw, k'uw*) being caught with a handline or by spear. Groupers are not considered to be very abundant. Snappers (*gooychaaf*) are caught on a handline or by spear at the reef edge. Jacks (*ngool, muul, qelqel*) are caught seaward of the reef using a hand line or by spear fishing.

Barracuda (*qanger, maal*) and rainbow runner (*foofow*) are found seaward of the ocean slope, but close to the edge and are caught infrequently as a by-catch while trolling for tuna. Other species also caught trolling, but farther offshore are tuna (*taguw*), wahoo (*malchath*), and dolphin fishes (*dabaar*). As in other sections, these species are not fished heavily. Dogtooth tuna (*yasul*) are caught near the entrance to Qeetuun Channel by trolling. Flying fishes (*goeg*) are found along these waters and are caught at night using a lantern to attract the fishes and scoop net to snare them. They are also caught during the day using the scoop net. Rainbow runner have been spotted and caught as far as five miles from the reef near the fishes aggregating devices located south of Gilmaan.

Yogyog or Trochus are found along the ocean reef slope throughout this Section. Fishermen reported harvesting them in June and July by diving. Turtles migrate along the ocean reef and are occasionally harvested for food. Likewise as in other Sections, fishermen reported that turtles are not as plentiful as before.

WATER QUALITY

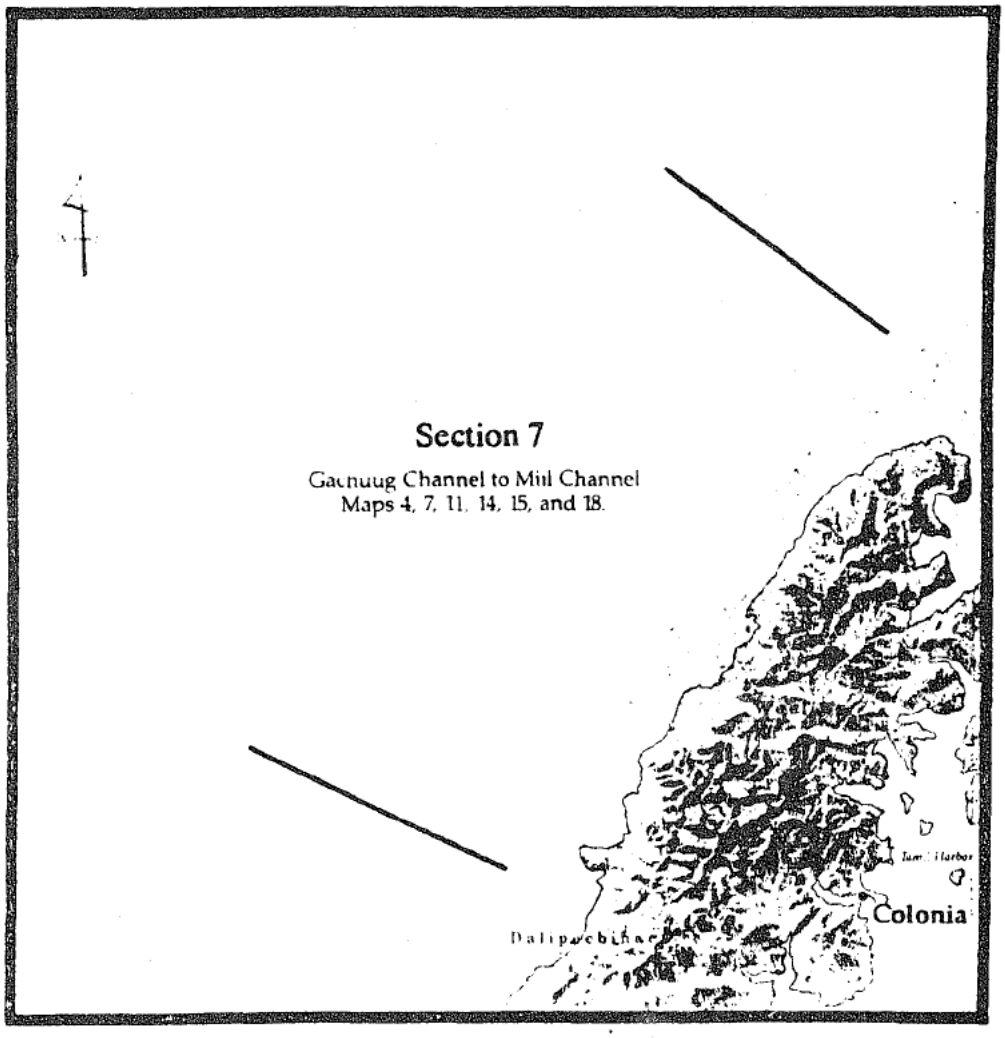
No point sources discharges are found in this Section. Non point sources are similar to those found in Section 2 [30]. The waters in the southwestern end of Gilmaan are classified as A. This portion contains beaches that may be developed as public recreational area. The rest of the waters are classified as AA [30]. The water quality of the two survey sites in this section were within the standards for all parameters [18]. There are no proposed or former dredge sites in this section.

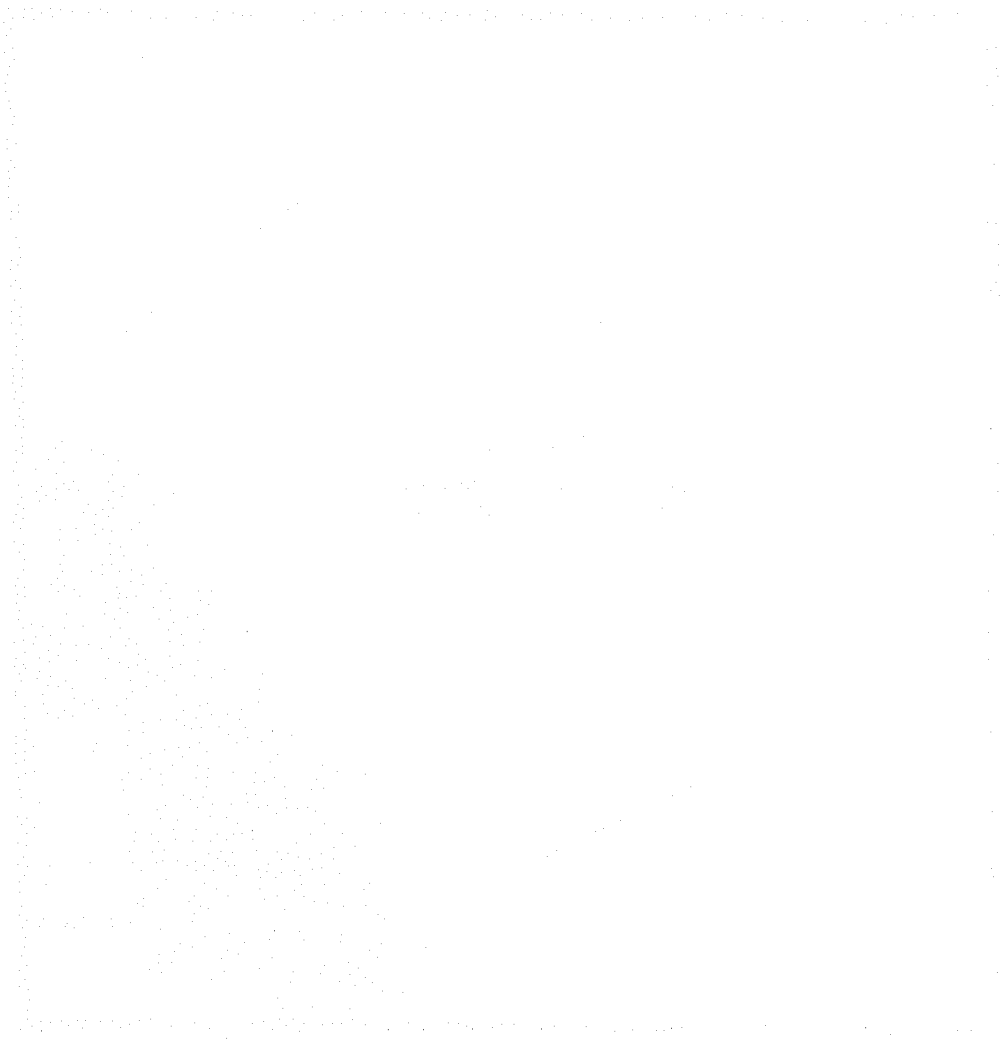
## SECTION 7: WESTERN DALIPEEBINAEW, WEELOEY, & FANIF

### GENERAL DESCRIPTION

This Section includes several municipalities on the leeward side of Yap Island (Figure 11). Gachuug Channel marks this section's southern boundary which continues north into Miil Channel and embayment. Included within this region are the municipalities of Dalipeebinaew, Weeloey, and Fanif. Also encompassed in the Section are four channels: Gachuug, Nimpal, Pearamach, and Miil. Adjacent to Nimpal Channel is a small boat harbor and pier project which is currently under construction.

**FIGURE 11. A MAP OF SECTION 7 WHICH INCLUDES THE AREAS OF WESTERN DALIPEEBINAEW, WEELOEY, & FANIF.**





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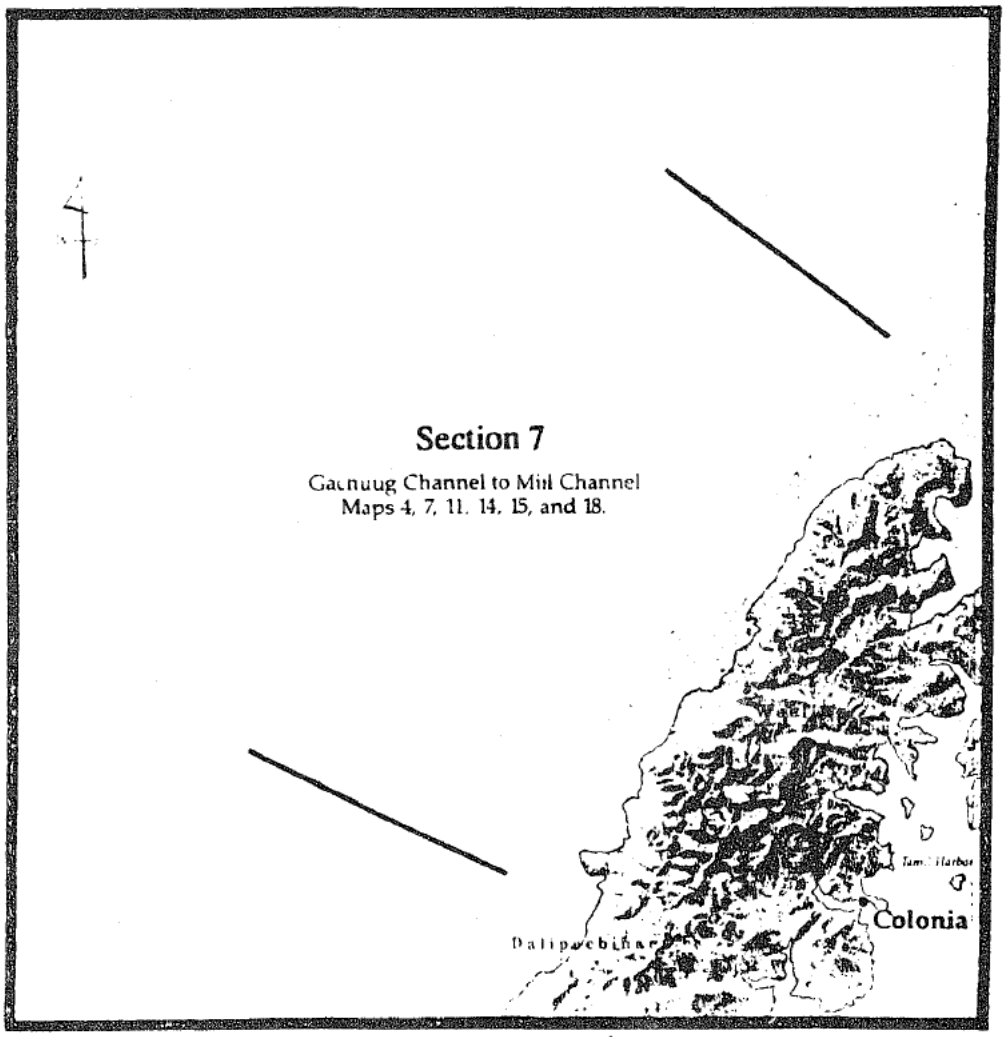

## PHYSIOGRAPHY

### Terrestrial Environment (Donguch)

Section 7 is comprised of the northwestern leeward side of Yap Island from Gachuug Channel north and extending to the northeastern land area of Fanif which borders the inner embayment of Miil Channel and the Tagireeng Canal (YCRI Stations 16, 16b, 17, 17a, 18a, 18b). This Section also includes the three channels of Nimpal, Pearamach and Miil which puncture the reef margin at fairly uniform intervals and several enclosed lagoon holes. The inner expanses of Miil Channel and several patch reefs are also discussed (YCRI Station 18b).

The central low hills of Yap Island quickly transform into a steeper series of ridges abutting the western terrestrial region of Section 4. The ridge elevations average around 100 meters (333 feet) in altitude along rounded and narrow hill tops. As with other Yap localities, the coastal slopes are steep flanks often ending in cliffs and bluffs 6-10 meters (20-30 feet) high at the shoreline. The hills of northern Yap are bordered by three peninsulas separated by shallow mangrove lined bays. Unlike the east coast, an almost continuous band of coastal plain lines the western side of Yap Island. For instance, along Qaringeel and Gaetmoqon, prominent coastal plains flank the steep headlands. Elsewhere, they are more narrow, but commonly fringed by a sand beach as in the coastline from Gilfith to Qayirech villages.

### Fringing Reef

The fringing reef of Section 7 constitutes both continuous stretches of uniform width along the western coastline (1.2 kilometers) and both irregular, and narrow widths within the inner embayment of Miil (150-200 meters). On the western ocean reef flat, nineteen enclosed lagoon holes punctuate the reef with the largest hole, Maqanpaaq/Ganafiif, extending almost the entire reef flat length between Nimpal and Gachuug Channels. Nimpal Channel represents the simplest channel configuration in Yap being both short and narrow. Conversely, Pearamach Channel appears more like a bay, despite is ocean reef front location, due to its 2 kilometer (1.25 mile) wide mouth and overall girth. Miil channel, however, has both a narrow mouth and meandering course before opening into a huge embayment featuring four lagoon patch reefs.

### Mangrove Forest (Malil)

Narrow, discontinuous belts of mangrove border the leeward shoreline of this Section. Between the villages Qokaaw and Raeng, the stand is densest and up to 300

meters (1000 feet) wide. Isolated pockets extend up to 200 meters (666 feet) inland north and south of this zone. Some mangrove reforesting is underway near Nimpal Channel to protect the southern fishing grounds which are being covered by silt from the eroding fishing harbor causeway under construction.

**Reef Flat**

On the nearshore reef flat, a 2-6 meter (6-20 feet) band of fine calcareous sand and terrigenous sediment borders the mangrove forests. This zone quickly merges with varying densities of seagrass and sand moving offshore with an occasional, isolated live coral microatoll. During low tide, much of this area is exposed completely to direct sunlight. A hard reef rock platform extends seaward to the reef margin edge. Along this wide flat expanse, sand is the predominate substrate with occasional patches of hard reef rock. Large monospecific staghorn coral thickets rising 1 meter (3 feet) high are widely distributed through the central reef moat in depths of 2-4 meters (6-12 feet).

Closer to the reef margin, the reef rises and becomes a pavement of cemented coral rubble and robust corals and microatolls. Continuous water movement over this region assists in scouring and with transporting fine sediments into the remnant lagoon basin. Closer to the margin of Miil channel, the reef flat is poorly developed due to strong tidal wave sheets and drainage into and out of the lagoon, preventing coral recruitment and settlement in the area.

The reef flat narrows substantially within the inner reaches of Miil embayment. In most places, the reef flat is not discernible due to deep silt deposits (0.5 meter). There are six large patch reefs located within the boundaries of the embayment which are completely submerged at all times. They are considered, however, significant navigational hazards and are marked with poles in the reef. Mangrove stands, up to 200 meters (666 feet) wide, fringe the interior shorelines of Maap Island and Fanif municipality.

On the leeward side of Maap, the reef flat borders the inner reaches of the Miil Channel embayment. Offshore of the mangrove shoreline, a narrow silty band merges with dense seagrass meadows interspersed with sand and some coral rubble. Moving gradually toward the Miil Channel margin, the abundance of microatolls steadily increases as sand and seagrass abundance decreases in water depths of only 1 meter or less. More frequently, patches of scoured reef rock are found with small sand deposits. The predominance and influence of terrigenous materials remains high to the channel's edge, with some Porites lutea heads exhibiting mucus secretions and bleaching along the reef flat

margin. During low tide, significant expanses of the reef flat landward are completely exposed. Along the channel margin, a 2-3 meter (6-10 feet) band of densely packed microatolls exists.

Cleared, shallow channels on the reef flat provide passageways to the Tagireeng Canal between Yap and Tamil-Gagil Islands and to Yinbinaew Channel between Maap and Tamil-Gagil Islands. Vessel passage through these are severely restricted during low tides while a low bridge connecting Maap and Gagil-Tamil Islands, restricts passage at high tides.

**Enclosed Lagoon Holes (Makef)**

Section 7 has eighteen enclosed lagoon holes located on the seaward reef flat. Likewise, these holes are irregularly shaped with Maqanpaaq/Ganafiif being the most elongate and irregular of all holes in this Section. Two reef holes were investigated to document the floral and faunal assemblages: Manqanpaaq/Ganafiif (YCRI Station 16a) and Woraqyal off the northern coast of Fanif (YCRI Station 18a).

The reefs fringing these lagoon holes are composed of a moderately diverse live coral assemblage. Coral relief is low along the hole's perimeter because of shallow water depths. Yet, various coral growth forms are evident including table, staghorn, massive, and corymbose species.

The reef slope descends steeply to the shallow sand bottom in water depths of 6-10 meters (20-33 feet) while exhibiting variable relief. Live corals include ramose, finger, massive, and encrusting coral species which average 50 percent coverage on hard surfaces. The hole's floor consists primarily of fine sand transported into the hole along with pieces of coral fallen from the adjacent slope.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Moving seaward from the back reef flat, the outer reef flat zone becomes less diverse and abundant and gradually merges into a flat, wave-inundated platform. At this location low, live coral microatolls are moderately abundant (in 1 meter depths). Deposits of coral fragments and shingle become common at the surf zone.

## Ocean Reef Slope (Waru 'e naa')

**Ocean Slope**

The leeward ocean terrace in this Section is similar to those of the previous Sections (YCRI Station 16, 17). The ocean slope is dominated by living reef corals at all depths

(100 percent coverage) with moderate diversity and high relief. The shallower depths (3-5 meters) include hard substrate patches veneered with massive and stout columnar species. Seaward, very irregular terracing with prominent and projecting coral relief, sometimes towering several meters in height, descends steeply to greater depths.

## FLORA

### Fringing Reef

**Mangrove Forest (Malil)**

The mangrove forest extends along most of the coastline with isolated pockets of varying densities commencing at Gachung. The thickest and most extensive stand begins at Nimpal off Qokaaw Village and extends to Raeng Village off Pearamach embayment. Some mangrove replanting has been initiated by Nimpal embayment.

**Reef Flat**

Along the shoreward margin of Pearamach Channel, the red alga Gelidiopsis intricata and Polysiphonia spp. continue to be common on the dead corals. Algae are patchily distributed along the reef flat with Halimeda opuntia, Caulerpa racemosa, and Hypnea pannosa occurring commonly.

The algal assemblage located adjacent to the new fishing pier and harbor project off Nimpal embayment has been modified slightly. Seagrasses continue to colonize the nearshore reef flat up to the borrow pit boundaries. At this interface, however, rapid recolonization of the bottom of the borrow pits has commenced. Along the southern borrow pits, the dominant benthos are Caulerpa racemosa (70 percent) and some Jania sp. growing on the sandy-silty substrate. The northern borrow pit is less dominated by algae, with Halimeda sp. being common.

**Enclosed Lagoon Holes (Makef)**

The reef structures of these lagoon holes typically had little algae development due in part to high populations of herbivorous fish. Similar to other lagoon holes, the red algae Gelidiopsis intricata and Polysiphonia spp. and the green alga Cladophora sp. commonly grow on the dead portions of corals. Elsewhere in the hole, several other algae species are present in crevices and pockets, but are considered rare. These include the green algae Halimeda discoidea, H. opuntia, Valonia fastigiata, V. ventricosa, the brown alga Dictyota friabilis, the red alga Actinotrichia fragilis, and the blue-green alga Microcoleus lyngbyaceus. The red alga Hypnea pannosa, although common in certain crevices in some lagoon holes (YCRI Station 16b), should be considered rare when overall percent cover is considered.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

The algal community is usually sparse near the margins of these fringing reefs,

leaving a relatively barren zone of sand, rubble, and hard reef rock pavement (including microatolls) along the reef edges. Red calcareous algae and some brown alga Turbinaria ornata and green algae Caulerpa spp. were noted on the shallow reef flat during the YCRI survey.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

Encrusting red coralline algae are common on the upper reef slope. Scattered and small patches of the green alga Halimeda spp. are generally found in pockets in the substrate at depths ranging from 5 to 15 meters.

### Fanoweag Patch Reef

The patch reef Fanoweag, located in the middle of Miil Embayment, consists primarily of soft coral species. The red alga Hypnea pannosa occurred commonly in the reef crevices while Halimeda discoidea and Caulerpa racemosa are also common on the reef. Rarely observed, but present are the green algae Tydemania expeditionis, Halimeda opuntia, Chlorodesmis fastigiata, and the red alga Amphiroa fragilissima.

## CORALS

### Fringing Reef

#### Reef Flat

Very limited coral growth appears on the inner reef flat which encompasses the mangrove, seagrass and reef flat interface. Coverage is generally limited to less than 5 percent and often much less than 1 to 2 percent. Terrestrial freshwater and silt, low tide reef flat exposure, and unsuitable sediment substrate all restrict coral development. For instance, by the villages of Gaetmoqon and Qokaaw which border Nimpal Channel, there are extensive reef flat areas several hundred meters wide, which are partially or completely exposed during low tides. Coral growth is scarce within these regions and on similar areas throughout Yap. When coral does occur on the sand, rubble, and silt of the inner reef flat, it is usually scattered Porites lutea microatolls.

Investigations of the Nimpal harbor and fishing causeway construction project (YCRI Station 16b) revealed the extent of the impact zone and recovery from previous dredging activities. Due to current and longshore transport, sediments appear to be trapped on the north side of the causeway (which is functioning like a groin). Thus, the northern borrow pits are filling in more quickly than the south side. Differences are also noticeable in the water depth and the degree of seagrass and algal colonization. Overall, there appears to be no evidence of significant adverse impact on the adjacent reef areas. On the northern adjoining reef flat, the branching corals Acropora aspera and Porites cylindrica are most abundant with the delicately branched Pocillopora damicornis and massive Gardineroseris planulata appearing commonly. A ramose Montipora digitata colony had fallen into the middle of the pit channel, that is dominated by the green alga Halimeda sp. On the southern reef flat adjacent to the borrow pit, live corals and seagrasses survive up to the margin of the borrow pit. Branching Montipora digitata and Acropora acuminata are abundant. Intermixed with these species are Pocillopora damicornis and Seriatopora hystrix, both delicately branched, and microatolls of Porites lutea. Also observed and presumably feeding on Montipora corals was the seastar Culcita.

#### Enclosed Lagoon Holes (Makef)

An interconnected network of live coral fringes the upper surfaces of most lagoon holes in this section (YCRI Station 16a and 18 A). Coral abundance and diversity are low near the sand bottom, but increases in both diversity and abundance along the upper slope and along the hole's fringing margin, averaging 50 percent coverage in depths less than 5

meters (15 feet). Low to moderate coral diversity characterizes both the reef margin and slope fauna with Acropora and Porites being dominant. Stout ramose Acropora and Porites microatolls form a densely packed coral assemblage that rings each hole's margin. Other common corals include the delicately branched Stylophora, Seriatopora, Pavona cactus and mounds of Favites. In 2-4 meter (6-13 feet) depths, extensive monospecific stands of Seriatopora hystrix are conspicuous features. Large ramose colonies of Porites cylindrica are dominant along the slope. Large thickets of Acropora acuminata, explanate plates of Pectinia paeonia and the columnar coral Porites (S.) rus add relief to the slope's composition. Other common corals include fire corals (Millepora), mushroom corals (Fungia), and heads of Hydnophora, Favia, and Goniopora. Below depths of 10 meters (33 feet), sand dominates the floor substrate of the hole, and coral cover falls between 0 to 20 percent.

**Inner Pearamach Channel**

The inner margin of Pearamach Channel was investigated and found to consist of a vertical wall that merged with a sediment talus slope at deeper depths (YCRI Station 17a). The fringing reef flat is dominated by diverse assemblage of living corals which averaged 75 percent coverage. Microatolls of Porites lutea are most abundant with massive heads of Goniastrea, Favia, and Platygyra being common. Ramose Acropora digitifera and thinly branched A. echinata and Seriatophora hystrix also appeared commonly on the fringing reef. Hard reef rock and massive corals appeared commonly on the channel walls. The diversity is high, although percent coverage is low, averaging 25 percent. Columnar colonies of Porites (S.) rus and P. cylindrica are abundant along the wall. Intermixed coral species included encrusting genera such as Merulina, Favites, Cyphastrea, and Physogyra.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Sand and coral rubble form a extensive veneer over areas of the outer reef flat which has only 0-10 percent live coral cover. Localized patches of dense, low branching Acropora have an overall coverage of 30-50 percent. As in other back reef areas, vertical coral growth is restricted by low tide limits which create a collar-like barrier to the open ocean. This zone of coral relief, sometimes 1 meter (3 feet) high, occurs further towards the outer reef flat margin and gradually merges into the smooth consolidated reef margin platform. The reef flat framework has a similar composition as the lagoon hole margins with stout ramose Acropora and large Porites microatolls being abundant. Seaward,

calcareous algae cements together and/or out competes other low cropped corals for substrate. Loose materials are abundant and are thrown up from the ocean fore reef by waves and are abraded and cobble-sized. When moving from the reef flat to the outer reef edge and high wave energy zone, live coral coverage diminishes rapidly. In this zone, scoured reef pavement and shingle dominate the substrate.

## Ocean Reef Slope (Waru 'e naa')

### Ocean Slope

The ocean slope in this section transforms from a typically steeply sloping "leeward" reef with a nearly vertical wall (YCRI station 16) to a more gradually sloping "windward" ocean reef (YCRI Station 17). [ Note: YCRI Station 17 is not geographically oriented correctly to truly call it a "windward" station, however, the ocean reef structure does exhibit windward reef characteristics.] There is high coral coverage at all depths, approaching between 90 and 100 percent in shallower localities. With the exception of overhangs in the shade, all surfaces are blanketed by lush coral development. Along the vertical slope, coverage averaged between 75-80 percent, which decreased to 50 percent coverage on the deeper faces of the wall.

Along the northwestern-facing portion of the ocean reef slope (YCRI Station 16), a gradually sloping terrace begins to drop off steeply at an 70 degree angle which changes into a nearly vertical wall, close to 30 meters (100 feet) high. The vertical drop begins at a depth of 7 meters (20 feet) and descends to a deeper terrace or shelf at about 60 meters (200 feet). Above 6 meters (20 feet), coral cover averages close to 100 percent. The most abundant coral genus found along the upper platform is Acropora. Many other corals are commonly found such as Platygyra, Echinophora, Pachyseris, Favia, Goniastrea, and the soft zooanthid coral Palythoa. Deeper and along the vertical wall, coral cover drops to 50 percent and features mostly encrusting species. Just below the drop off, narrow ledges with overhanging coral platelets create cave-like habitat for other fauna, particularly fishes.

At YCRI Station 17, the topographic relief is highly variable with many knolls and depressions. Some large massive species such as Porites lichen, Leptoria phrygia, and Platygyra daedalea are intermixed with three-dimensional and more fragile species. These include explanate plates of Echinophora lamellosa, Mycedium elephantotus and numerous ramose and cespitose species of Acropora. On the rolling terraces below, a combination of irregular growth forms are present which create an area of highly variable relief. Giant hemispherical corals of Porites and Platygyra, rising 2-3 meters (6-10 feet) in the water

column, are situated between whorls and fields of the foliaceous coral Echinophyllia aspera and the staghorn coral Acropora. Commonly intermixed is a variety of other corals including columnar colonies of Porites (S.) rus, partially hidden plates of Galaxea, and Acropora, including both table and arborescent forms. Less conspicuous and found only occasionally are Leptastrea, Symphyllia, Montipora, Favia, Favites, Diploastrea, and Pachyseris.

## OTHER INVERTEBRATES

### Fringing Reef

#### Reef Flat

These reef flats support sponges in both coral and seagrass communities. A branching green sponge resembling Clathria cervicornis and a brown sponge are scattered among seagrasses. Dyisdea herbacea forms encrusting colonies on limestone substrates of coral communities. Hard substrates of the reef flat support three species of sponges. Styloterra aginata is common in areas of scattered coral heads on pavement. Occasional individuals of a black sponge and a brown sponge may be observed on reef rocks.

Seagrass areas with fine sediments covering the substrate provide habitat for occasional medusae of the benthic scyphozoan Cassiopea medusa. The soft corals Sinularia spp. are common on reef rocks of coral communities.

The only conspicuous mollusc of the reef flats is the vermetid Dendropoma maxima. These sessile gastropods are found on scattered coral heads and reef rocks of coral communities. The blood-mouth conch Strombus luhuanus is present, but rare in sandy substrates. Giant clams are present, but not common. Tridacna maxima is scattered on reef rocks, and Hippopus hippopus is present, but rare.

Sea cucumbers inhabit both seagrass and coral communities of the reef flat. Stichopus chloronotus and Holothuria atra may be found on soft substrates scattered throughout the coral community, and Holothuria edulis is present, but rare. The seagrass meadow supports populations of Holothuria atra and Synapta maculata, but neither species is common. The seastar Acanthaster planci, a predator on corals, is present, but rarely observed.

The soft coral Asterospicularia randalli is present in considerable abundance in areas exposed to strong currents. The soft coral Xenia sp. is common and an unidentified species is present but rare.

The didemnid ascidian Didemnum molle is abundant on the reef flat. These tunicates inhabit reef rocks and dead corals.

#### Enclosed Lagoon Holes (Makef)

A brown species of sponge is found in abundance among reef rocks and coral heads of the upper lagoon slope of Maqanpaaq Hole (YCRI Station 16a). The orange species Styloterra aginata and a red species are present, but these sponges are not common in this habitat. A diversity of sponges may be found in some enclosed lagoon holes (YCRI

17a,18a). Styloterra aginata are commonly associated with reef rocks on the upper slopes. Two testillid sponges are present beneath coral overhangs; cf. Cinachyra sp. is common, and testillid sp. 1 is uncommon. A black sponge may be found on the upper slope, and an encrusting brown sponge is present, but rare.

An abundance of the large stinging hydroid Aglaophenia cupressina is found in the lagoon holes of Fanif. These hydroids attain their greatest abundance in colonies of the coral Porites cylindrica at 9 meter (30 feet) depths. The stoloniferan Clavularia sp. is commonly observed on the slope, and this species is abundant in some areas. The soft corals Sarcophyton sp. and Symnodium coeruleum and the wire coral Cirrhipathes sp. are present, but they are not common.

The sessile small Dendropoma maxima is abundant on coral heads and reef rocks of the upper slope of some lagoon holes.Two species of epibenthic polychaete annelids occupy enclosed lagoon holes. The Christmas-tree worm Spirobranchus giganteus is abundant in massive poritid coral colonies. Occasional individuals of the feather-duster worm Sabellastarte sanctijosephi can be observed extending from their parchment tubes.

Molluscs are not a conspicuous element of the macrobenthos in enclosed lagoon holes. The tiger cowrie Cypraea tigris is present, but rarely encountered. The boring ark Arca ventricosa and the thorny oyster Spondylus cf. squamosus may be observed on the upper slope, but they are not common. The cockscomb oyster Lopha cristagalli occurs under ledges of the lower slope, where it is rare. The spider conch Lambis lambis is present on shingle. The boring bivalve Pedum spondyloideum is present, but not common.

Echinoderms comprise a diverse faunal component of the macrobenthos, but no species is common. The seastars Culcita novaeguineae, Fromia sp, and Linckia laevigata are rarely encountered on the upper slope. Acanthaster planci is present, but rare on living corals. Scattered individuals of Holothuria edulis and Bohadschia argus may be observed on the upper slope along with Synapta maculata, which is rare in this habitat. The lagoon floor is inhabited by the large sea cucumbers Thelenota ananas, Thelenota anax, and Holothuria axiologa.

One species of ascidian is abundant in the lagoon. The zoochlorellae-associated tunicate Didemnum molle occupies dead corals and reef rocks throughout the slope. Reef rocks and dead corals are occupied by the tunicate Eudistoma cf. viride. These ascidians are abundant in this habitat.

## Ocean Reef Slope (Waru 'e naa')

The ocean terrace provides habitat for an abundance of the zoantharian cf. Actinodiscus sp. These solitary zoanthids form dense aggregations on limestone pavement of the terrace. The clownfish anemone Heteractis magnifica may be encountered on the upper slope, but the species is rare.

Octocorals are the most diverse macroinvertebrates of the ocean terrace. Sinularia spp. are abundant. Lobophytum spp. and Sarcophyton sp. are present, but not common. The clownfish anemone Heteractis magnifica varies from occasional to rare in localized areas.

Polychaete worms of the ocean terrace are represented by the Christmas-tree worm Spirobranchus giganteus. These polychaetes inhabited the encrusting reef coral Montipora and massive reef coral colonies of Porites at this location.

The commercial topshell Trochus niloticus is scattered on pavement of the terrace. The giant clam Tridacna maxima extends over a depth range of 6-10 meters (20-33 feet), but is not common in this habitat. Trochus niloticus shells measuring 7-8 cm provide refuge for the hermit crab Dardanus megistos, which is present, but not common.

Echinoderms exhibit low diversity on the ocean terrace. The terrace provides refuge for Comanthus cf. parvicirrus. These nocturnal crinoids are commonly observed in recesses in the reef framework at 11 meter (36.3 feet) depths. Other echinoderms present include scattered specimens of the seastar Linckia multifora and the boring urchin Echinostrephus cf. aciculatus, Acanthaster planci are present, but rarely encountered.

The tunicate Didemnum molle may be observed here, but the species is common to rare. As elsewhere, the species occupies dead coral and limestone substrates.

Section 7

## FISHES

### Fringing Reef

#### Mangrove Forest (Malil)

A mangrove forest exists along most of the coastline in Section 7 and is densest along the interior reaches of Miil Embayment. The mangroves provide habitats for larval and juvenile forms of a number of fish species.

#### Reef Flat

Seagrass beds are adjacent to the mangrove forest and extend several hundred meters seaward of the reef flat. A moderately diverse fish community is established in this zone, which increases in diversity with distance from shore and increasing reef structure complexity. Near the Nimpal harbor and fishing pier project, the faunal community suggests its progression toward a more stable community with time despite previous destruction of habitat due to dredging. The adjacent seagrass beds provide habitat for small butterfly fishes (Chaetodon ephippium, C. trifasciatus) cryptic gobies (Acentrogobius sp.1, Amblygobius phalaena) and in the scattered colonis of branched corals, territorial damsel fishes such as Stegastes spp., Dascyllus aruanus, and Chromis viridis. Compared to the adjacent embayment and lagoon holes, the diversity is fairly low featuring only 14 families and 37 species. Yet, the assemblage reflects new habitat types with the occurrence of small schools of jacks (Caranx melampygus) and parrot fishes (Leptoscarus vaigiensis and Scarus sp. (juveniles)). Additionally, the honey-comb grouper, Epinephelus merra appeared regularly unlike other seagrass areas. The proximity of this station to nearby, lagoon hole environments and access to the deeper Nimpal embayment, may account for the numerous observations of these species. Additionally rapid recolonization and species recruitment may be partially attributed to the closeness of Nimpal Channel.

#### Enclosed Lagoon Holes (Makef)

The lush coral development within the lagoon holes present a variety of habitats which support a highly diverse fish community. The two lagoon hole stations (YCRI 18, 16a) investigated had over 19 fish families representing 80 different species. Families with the most diverse assemblage are Labridae (wrasses), Pomacentridae (damsel fishes), and Chaetodontidae (butterfly fishes). Fast swimming schools of rudder fish (Kyphosus cinerascens and monocle breams (Scolopsis sp.) moved through the holes while groups of parrot fishes (juvenile Scarus sp., S. oviceps, S. schlegeli, and S. sordidus), goat fishes

(Mulloides flavolineatus), and snappers (Gnathodentex aureolineatus, Lutjanus fulvus, L. gibbus) appeared commonly. Localized coral reef thickets and mounds provided cover for a small commonly observed grouper (Epinephelus merra) and squirrel fishes (Sargocentron spp.). Territorial, and sometimes aggressive damsel fishes (Stegastes nigricans, Amblyglyphidodon curacao), darted between coral fingers and mounds, while groups of Chromis viridis perched above the coral fingers.

**Inner Pearamach Channel**

The channel margin of Pearamach Channel is ringed with microatolls and ramose coral species while the coral development along the walls is less pronounced. Due to tidal fluctuation which expose the reef flat at low tide, the fish community tends to increase with depth. Seventeen families representing 65 individual species were observed with Labridae (wrasses) being the most diverse family. Wrasses frequented the reef flat as did damsel fishes (Amblyglyphidodon curacao, Chromis sp. and Stegastes sp.). Butterfly fishes also darted along the reef flat. Along the wall, the faunal community included small groups of monocle breams (Scolopsis lineatus), parrot fishes (Scarus oviceps, S. sordidus, S. spinus and juvenile Scarus spp.). Medium sized groupers (Epinephelus merra, Cephalopholis urodeta) resided underneath coral ledges and overhangs, as did the squirrel fish, Sargocentron microstoma.

## Ocean Reef Slope (Waru 'e naa')

**Ocean Slope**

The diversity of the fish community increases again on the reef terrace seaward of the high energy, wave-washed zone. The terrace possesses a well-developed coral community, providing numerous habitat types for over 20 fish families. Nocturnal fishes such as squirrel fishes, (Myripristis spp., Sargocentron spp.) hovered underneath coral overhangs and in small caves as did black bronze sweepers (Pempheris oualensis). Amongst the coral reef, damsel fishes (Chromis margaritifer, C. ternatensis, C. atripectoralis, Abudefduf sexfasciatus) and groups of the pyramid butterfly fish (Hemitaurichthys polylepis) appeared commonly and throughout the reef. Predator species including the emperor bream (Monotaxis grandoculis), snappers (Lutjanus fulvus, L. gibbus, Macolor niger) and the spotted grouper (Cephalopholis argus) swam close to the reef structure. Rudder fish (Kyphosus cinerascens) and several multi-species schools of fusiliers (Pterocaesio tile, Caesio teres) cruised through the survey area as did foraging

parrot fish groups (Scarus frenatus, S. niger, S. oviceps, S. schlegeli and S. sordidus). Acanthurids (surgeon fishes) are well represented on the ocean reef with the black tang (Zebrasoma scopas) and unicorn fish (Naso brevirostris) occurring commonly.

## OTHER MARINE VERTEBRATES

During the YCRI field survey, no green sea turtles were observed on either the reef flat or ocean reef. Local fishermen, however, described all seagrass pastures as potential turtle feeding grounds. Fishermen indicated that turtles were frequently seen in the enclosed lagoon holes and along Miil Channel. An unidentified pod of dolphins or porpoises was also observed offshore near the vicinity of YCRI Stations 17 and 18.

Section 7

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Powerful villages were present in these areas in the late 1800s -- Kanif in Dalipeebinaew, Qokaaw in Weeloey, and Gilfith and Raeng in Fanif. Kanif was allied to Ngolog in Ruul. In contrast, the powerful villages in Weeloey and Fanif were allied to Tamil. Qokaaw and Kanif play prominent roles in the oral histories of the late 1800s relating to political affairs [75].

Archaeological work in these areas is confined to reconnaissance surveys of the housing areas of Qaringeel and Kanif in Dalipeebinaew and Qokaaw and Minef in Weeloey [16,17]. Limited excavations were also conducted in one site in Kanif where dates back to the A.D. 1700s, + 200 years, were reported [42]. Also, a social anthropologist has prepared a reconnaissance level map of similar areas of Raeng village in Fanif. Kanif and Qokaaw both have faeluw in the coastal mangroves, shielding the villages. Considerable amounts of reclaimed sand flats are clearly visible at Qokaaw, with associated retaining walls. Qaringeel is somewhat different in terrain, being a jutting peninsula with little flat land. Taro systems here are small, interlinked pits, while Kanif and Qokaaw have large taro patches as well as interlinked small pits. Only one fish trap has been archaeologically recorded in this region, in Qaringeel [16,17]; many more undoubtedly remain to be studied.

## RESOURCE USES

Information for this section was based on interviews with fishermen from Dalipeebinaew, Fanif and Weeloey municipalities (Appendix F).

### Terrestrial

Freshwater shrimp (*ganeef*) are found in small numbers in upland streams along the western side of Fanif and Weeloey but are rarely harvested.

This Section has few beaches, although development of a public beach park near Raeng village in Fanif municipality was proposed in the Tourism Plan [26]. Improvements to this beach and to the road from Colonia to Raeng will provide a recreational facility to serve Colonia and the west side of the island. Additionally, this would also serve as a tourist destination on a tour route through this side of the island. Rugged terrain, the lack of sand beaches, shallow mud flats along the shoreline in Miil embayment and unimproved roads make the northern Fanif municipality less desirable for resort development. Resort development near Raeng could be possible, especially if the road from Colonia is paved.

### Fringing Reef

#### Mangrove Forest (Malil)

The mangrove forest extends along most of the coastline with mangrove stands of varying densities commencing at Gachung. Mangrove crab (*qamaang*) and land crab (*galip*) are found throughout the forests and are occasionally harvested. The swimming crab (*qurich)* is also found along the western shoreline in large quantities and size. The mud clam (*yungwol*) is found on the reef flats along Miil Channel in Fanif. They are harvested occasionally, but are not considered an important food item. Mullet (*quloch, galaed*) continue to be plentiful along the mangroves. They are caught typically during high tide with a gill net.

Large mangrove stands from Raeng to Gaetmoqon on the western side and on the northern tip of Yap Island may have the potential to be selectively harvested. As with other areas however, there is a question of whether the scale of sustainable harvesting would make it economically feasible. No commercial harvest should be allowed until a harvesting management plan with adequate monitoring provisions is developed.

A new road alignment is planned to cut through the western mangrove forest at Raeng. This should be re-routed to pass along the edge of the mangrove.

Section 7

**Reef Flat**

Seagrasses continue to colonize the nearshore reef flat which merges with a sand and coral complex zone extending out to the outer reef margin. Rabbit fishes (*dayit, garmiy, buywod, darruy, limreq*), goat fishes (*manguch, mbing, soong*), emperor fishes (*wul, qoeyeq, gadgad)* and milk fishes (*guuguw, tangir*) are plentiful here. Typically they are harvested by using a gill net or surround net. Eels (*looth)* and sea cucumbers (*l'ugul)* are found throughout the reef flats, but are not normally fished.

Fish trap sites are located near the enclosed lagoon holes of Luul and Tanaqen and by the reef flat extensions of Gipey and Raek. Their use, however, has diminished and are not used extensively by fishermen today.

Three existing dredge sites are found in this section. Two of the sites, one near Kanif and the other on Faay inlet on Miil Channel were previously investigated [105]. Both sites could be dredged further under conditions recommended by Pacific Basin Environmental Consultants [105]. The third site is located adjacent to Nimpal Channel. This site was dredged to build a boat channel from the shoreline to Nimpal Channel to accommodate a need for a fisheries port on the leeward side of the island. Currently, there is no facility on that side of the island to land fish. Consequently, commercial vessels used by Yap Fishing Authority must travel around the island to Colonia to land their catch. Construction of the channel would allow deeper draft fishing vessels shore access regardless of the tide level. Any additional unused fill material should be removed and stockpiled on land for future projects such as road improvements.

**Seaward Reef Flat (Lan e rayem \ Daken 'e naa')**

Commonly found species on the outer reef flat are also harvested in this Section. These fishes are parrot fishes (*qelbad, qalaabal, malngoed*), surgeon fishes (*quum, maath, machagwog, bilaew*), rudder fishes (*guumiy)*, angel fishes (*qeer, buloch*), and trigger fishes (*wuuq, moelngith, nguuf*). Typically, fishermen harvest these fishes by gill nets and spear fishing. Emperor breams (*qutun*) are also found here, but are harvested by hand line or spear fishing.

**Ocean Reef Slope (Waru 'e naa')**

**Ocean Slope**

The ocean reef fisheries are abundant and diverse. Fishermen report catching groupers although infrequently. Snappers (*gooychaaf, gadaw)* are found along the reef's

edge on the drop offs. They are harvested by handline and spear fishing. Jacks (*ngool, muul, qelqel*) are found seaward of the reef and are caught using handline or spear fishing.

Barracuda (*qanger, maal*) and rainbow runner (*foofow)* are found seaward of the ocean slope, but close to the edge. Other species also caught trolling, but farther offshore are tuna (*taguw)*, wahoo (*malchath*), and dolphin fishes (*dabaar*). As in other sections, these species are not fished heavily since a power boat is needed.

Topshells (*yogyog*) are harvested by diving along the ocean reef slope. Commercial harvesting by this Section's fishermen occurs in compliance with guidelines setforth by MRMD. Turtles migrate along the ocean reef, although in smaller numbers than historically reported. Whenever found by fishermen, the turtle is harvested. Giant clams (*kiim*), which are no longer found in this Section, were probably fished out according to the fishermen, thus leading to their extirpation within the Yap Proper reef areas.

Section 7

## WATER QUALITY

No point source discharges were found in this area. Non-point discharges are generally the same as those found in Section 2 [30]. The waters in Fanif from Raeng to near Yyin are classified as A to reflect the potential development of a beach park and water recreational area. All other waters in this section are classified as AA. Fecal coliform and total coliform levels exceeded standards for A waters for one of three testing dates at the only station in this section. All other parameters for this section for each testing date were within the minimum levels [18].

Three dredged sites or former dredge sites are located in this section. Two sites one at Kanif and the other in Faay Channel in Miil embayment are not in use. The third site at Gaetmoqon is being dredged to provide fill for a boat channel to Nimpal Channel. Work has been temporarily discontinued due to equipment problems. The causeway is slowly eroding and spreading fine sediment down current of the site. Thus, this area may be in violation of the water quality standard for turbidity. However, no testing has been done at the site in the last two years [37].

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# APPENDICES

Appendix A

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| ALGAE | STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | SECTION 1 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANTHOPHYTA | | | | | | | | | | | | | | |
| Cymodocea rotundata | | | | | | | | | C | | | | | |
| Enhalus acoroides | | | | | | | | | C | | | | | |
| Thalassia hemprichii | | | | | | | | | C | | | | | |
| CYANOPHYTA (blue-green) | | | | | | | | | | | | | | |
| Fam. Chamaesiphonaceae | | | | | | | | | | | | | | |
| Entophysalis sp. | | | | | | | | | | | | | | |
| Fam. Nostocaceae | | | | | | | | | | | | | | |
| Calothrix scopulorum | | | | | | | | | | | | | | |
| Hormothamnion enteromorphoides | | | | | | | | | | | | | | |
| Fam. Oscillatoriaceae | | | | | | | | | | | | | | |
| Microcoleus lyngbyaceus | | | | | | | | R | | | | | | |
| Schizothrix calcicola | | | | | | | | | | | | | | |
| Schizothrix mexicana | | | | | | | | | | | | | | |
| Fam. Unknown | | | | | | | | | | | | | | |
| blue-green algae | | | | | | | | | | | | | | |
| CHLOROPHYTA (green) | | | | | | | | | | | | | | |
| Fam. Ulvaceae | | | | | | | | | | | | | | |
| Avrainvillea obscura | | | | | | | | | | | | | | |
| Enteromorpha clathrata | | | | | | | | | | | | | | |
| Fam. Bryopsidaceae | | | | | | | | | | | | | | |
| Bryopsis pennata | | | | | | | | | | | | | | |
| Fam. Caulerpaceae | | | | | | | | | | | | | | |
| Caulerpa cupressoides | | | | | | | | | | | | | | |
| Caulerpa peltata | | | | | | | | | | | | | | |
| Caulerpa racemosa | | | | | | | | | C | | | | | |
| Caulerpa serrulata | | | | | | | | | | | | | | |
| Caulerpa sertularioides | | | | | | | | | | | | | | |
| Caulerpa taxifolia | | | | | | | | | | | | | | |
| Caulerpa urvilliana | | | | | | | | | | | | | | |
| Caulerpa verticillata | | | | | | | | | | | | | | |
| Fam. Codiaceae | | | | | | | | | | | | | | |
| Chlorodesmis fastigiata | | | | | | | | | | | | | | |
| Chlorodesmis sp. | | | | | | | | | | | | | | |
| Cladophora sp. | | | | | | | | | | | | | | |
| Codium arabicum | | | | | | | | | | | | | | |
| Codium edule | | | | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | | | | |
| Halimeda cylindracea | | | | | | | | | | | | | | |
| Halimeda discoidea | | | | | | | | | | | | | | |
| Halimeda gigas | | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Halimeda incrassata | | | | | | | | | | | | | |
| Halimeda macroloba | | | | | | | | C | | | | | |
| Halimeda macrophysa | | | | | | | | | | | | | |
| Halimeda opuntia | | | | | | | | | | | | | |
| Halimeda sp. | | | | | | | | | | | | | |
| Halimeda taenicola | | | | | | | | | | | | | |
| Rhipilia sp. | | | | | | | | | | | | | |
| Tydemania expeditionis | | | | | | | | | | | | | |
| Udotea indica | | | | | | | | | | | | | |
| Fam. Boodleaceae | | | | | | | | | | | | | |
| Boodlea composita | | | | | | | | | | | | | |
| Fam. Siphonocladaceae | | | | | | | | | | | | | |
| Cladophoropsis sp. | | | | | | | | | | | | | |
| Fam. Valoniaceae | | | | | | | | | | | | | |
| Dictyosphaeria cavernosa | | | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | | | |
| Valonia aegagropila | | | | | | | | | | | | | |
| Valonia fastigiata | | | | | | | | | | | | | |
| Valonia ventricosa | | | | | | | | | | | | | |
| Fam. Dasycladaceae | | | | | | | | | | | | | |
| Acetabularia moebii | | | | | | | | | | | | | |
| Neomeris annulata | | | | | | | | | | | | | |
| Neomeris vanbosseae | | | | | | | | | | | | | |
| Fam. Anadyomenaceae | | | | | | | | | | | | | |
| Microdictyon okamurai | | | | | | | | | | | | | |
| Fam. Cladophoraceae | | | | | | | | | | | | | |
| Chaetomorpha sp. | | | | | | | | | | | | | |
| Cladophora fascicularis | | | | | | | | | | | | | |
| PHAEOPHYTA (brown) | | | | | | | | | | | | | |
| Fam. Ectocarpaceae | | | | | | | | | | | | | |
| Ectocarpus breviarticulatus | | | | | | | | | | | | | |
| Feldmannia indica | | | | | | | | | | | | | |
| Fam. Ralfsiaceae | | | | | | | | | | | | | |
| Ralfsia occidentalis | | | | | | | | | | | | | |
| Fam. Sphacelariaceae | | | | | | | | | | | | | |
| Sphacelaria tribuloides | | | | | | | | | | | | | |
| Sphacelaria sp. | | | | | | | | | | | | | |
| Fam. Dictyotaceae | | | | | | | | | | | | | |
| Dictyopteris repens | | | | | | | | | | | | | |
| Dictyota bartayresii | | | | | | | | | | | | | |
| Dictyota divaricata | | | | | | | | | | | | | |
| Dictyota friabilis | | | | | | | | | | | | | |
| Lobophora variegata | | | | | | | | | | | | | |
| Padina japonica | | | | | | | | | | | | | |
| Padina tenuis | | | | | | | | | | | | | |
| Fam. Sargassaceae | | | | | | | | | | | | | |
| Turbinaria ornata | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 1 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b | |
| RHODOPHYTA (red) | | | | | | | | | | | | | | |
| Fam. Acrochaetiaceae | | | | | | | | | | | | | | |
| Acrochaetium sp. | | | | | | | | | | | | | | |
| Fam. Bonnemaisoniaceae | | | | | | | | | | | | | | |
| Asparagopsis taxiformis | | | | | | | | | | | | | | |
| Fam. Chaetangiaceae | | | | | | | | | | | | | | |
| Galaxaura filamentosa | | | | | | | | | | | | | | |
| Galaxaura oblongata | | | | | | | | | | | | | | |
| Fam. Gelidiaceae | | | | | | | | | | | | | | |
| Gelidiella acerosa | | | | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | C | | | | | | | |
| Gelidium pusillum | | | | | | | | | | | | | | |
| Gracilaria salicornia | | | | | | | | | | | | | | |
| Gracilaria sp. | | | | | | | | | | | | | | |
| Fam. Gracilariaceae | | | | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | | | | | | | |
| Fam. Corallinaceae | | | | | | | | | | | | | | |
| Actinotrichia fragilis | | | | | | | | | | | | | | |
| Amphiroa fragilissima | | | | | | | | | | | | | | |
| Amphiroa sp. | | | | | | | | | | | | | | |
| Jania capillacea | | | | | | | | | | | | | | |
| Lithothamnion sp. | | | | | | | | | | | | | | |
| Neogoniolithon frutescens | | | | | | | | | | | | | | |
| Porolithon gardineri | | | | | | | | | | | | | | |
| Porolithon onkodes | | | | | | | | | | | | | | |
| Fam. Cryptonemiaceae | | | | | | | | | | | | | | |
| Halymenia sp. | | | | | | | | | | | | | | |
| Fam. Peyssonneliaceae | | | | | | | | | | | | | | |
| Peyssonnelia rubra | | | | | | | | | | | | | | |
| Fam. Hypneaceae | | | | | | | | | | | | | | |
| Hypnea esperi | | | | | | | | | | | | | | |
| Hypnea pannosa | | | | | | | | | | | | | | |
| Fam. Ceramiaceae | | | | | | | | | | | | | | |
| Centroceras clavulatum | | | | | | | | | | | | | | |
| Ceramium sp. 1 | | | | | | | | | | | | | | |
| Ceramium sp. 2 | | | | | | | | | | | | | | |
| Herposiphonia tenella | | | | | | | | | | | | | | |
| Polysiphonia scopulorum | | | | | | | | | | | | | | |
| Polysiphonia sp. | | | | | | | | | | | | | | |
| Polysiphonia spp. | | | | | | | | | | | | | | |
| Spyridia filamentosa | | | | | | | | | | | | | | |
| Tolypiocladia glomerulata | | | | | | | | | | | | | | |
| Wrangelia sp. | | | | | | | | | | | | | | |
| Fam. Delesseriaceae | | | | | | | | | | | | | | |
| Martensia fragilis | | | | | | | | | | | | | | |
| Fam. Rhodomelaceae | | | | | | | | | | | | | | |
| Laurencia papillosa | | | | | | | | | | | | | | |
| Laurencia parvipapillata | | | | | | | | C | | | | | | |
| Laurencia sp. | | | | | | | | | | | | | | |
| Neogoniolithon sp. | | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ALGAE | | | | | | | | | | | |
| ANTHOPHYTA | | | | | | | | | | | |
| Cymodocea rotundata | | | | | | | | | | | |
| Enhalus acoroides | | | | | | | | | | | |
| Thalassia hemprichii | | | | | | | | | | C | |
| CYANOPHYTA (blue-green) | | | | | | | | | | | |
| Fam. Chamaesiphonaceae | | | | | | | | | | | |
| Entophysalis sp. | | | | | | | | | | | |
| Fam. Nostocaceae | | | | | | | | | | | |
| Calothrix scopulorum | | | | | | | | | | | |
| Hormothamnion enteromorphoides | | | | | | | | | | | |
| Fam. Oscillatoriaceae | | | | | | | | | | | |
| Microcoleus lyngbyaceus | | | | | | | C | | | | |
| Schizothrix calcicola | | | | | | | | | | | |
| Schizothrix mexicana | | | | | | | | | | | |
| Fam. Unknown | | | | | | | | | | | |
| blue-green algae | | | | | | | | | | | |
| CHLOROPHYTA (green) | | | | | | | | | | | |
| Fam. Ulvaceae | | | | | | | | | | | |
| Avrainvillea obscura | | | | | | | | | | | |
| Enteromorpha clathrata | | | | | | | | | | | |
| Fam. Bryopsidaceae | | | | | | | | | | | |
| Bryopsis pennata | | | | | | | | | | | |
| Fam. Caulerpaceae | | | | | | | | | | | |
| Caulerpa cupressoides | | | | | | | | | | | |
| Caulerpa peltata | | | | | | | | | | | |
| Caulerpa racemosa | | | | | | | C | | | | |
| Caulerpa serrulata | | | | | | | | | | | |
| Caulerpa sertularioides | | | | | | | | | | | |
| Caulerpa taxifolia | | | | | | | R | | | | |
| Caulerpa urvilliana | | | | | | | | | | | |
| Caulerpa verticillata | | | | | | | | | | | |
| Fam. Codiaceae | | | | | | | | | | | |
| Chlorodesmis fastigiata | | | | | | | | | | | |
| Chlorodesmis sp. | | | | | | | | | | | |
| Cladophora sp. | | | | | | | | | | | |
| Codium arabicum | | | | | | | | | | | |
| Codium edule | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | |
| Halimeda cylindracea | | | | | | | | | | | |
| Halimeda discoidea | | | | | | | | | | | |
| Halimeda gigas | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Halimeda incrassata | | | | | | | | | | | |
| Halimeda macroloba | | | | | | | | | | | |
| Halimeda macrophysa | | | | | | | | | | | |
| Halimeda opuntia | | | | | | | | | | | |
| Halimeda sp. | | | | | | | | | | | |
| Halimeda taenicola | | | | | | | | | | | |
| Rhipilia sp. | | | | | | | | | | | |
| Tydemania expeditionis | | | | | | | | | | R | |
| Udotea indica | | | | | | | | | | | |
| Fam. Boodleaceae | | | | | | | | | | | |
| Boodlea composita | | | | | | | | | | | |
| Fam. Siphonocladaceae | | | | | | | | | | | |
| Cladophoropsis sp. | | | | | | | | | | | |
| Fam. Valoniaceae | | | | | | | | | | | |
| Dictyosphaeria cavernosa | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | |
| Valonia aegagropila | | | | | | | | | | | |
| Valonia fastigiata | | | | | | | | | | | |
| Valonia ventricosa | | | | | | | R | | | | |
| Fam. Dasycladaceae | | | | | | | | | | | |
| Acetabularia moebii | | | | | | | | | | | |
| Neomeris annulata | | | | | | | | | | | |
| Neomeris vanbosseae | | | | | | | | | | | |
| Fam. Anadyomenaceae | | | | | | | | | | | |
| Microdictyon okamurai | | | | | | | | | | | |
| Fam. Cladophoraceae | | | | | | | | | | | |
| Chaetomorpha sp. | | | | | | | | | | | |
| Cladophora fascicularis | | | | | | | | | | | |
| PHAEOPHYTA (brown) | | | | | | | | | | | |
| Fam. Ectocarpaceae | | | | | | | | | | | |
| Ectocarpus breviarticulatus | | | | | | | | | | | |
| Feldmannia indica | | | | | | | | | | | |
| Fam. Ralfsiaceae | | | | | | | | | | | |
| Ralfsia occidentalis | | | | | | | | | | | |
| Fam. Sphacelariaceae | | | | | | | | | | | |
| Sphacelaria tribuloides | | | | | | | | | | | |
| Sphacelaria sp. | | | | | | | | | | | |
| Fam. Dictyotaceae | | | | | | | | | | | |
| Dictyopteris repens | | | | | | | | | | | |
| Dictyota bartayresii | | | | | | | | | | | |
| Dictyota divaricata | | | | | | | | | | | |
| Dictyota friabilis | | | | | | | | | | | |
| Lobophora variegata | | | | | | | | | | | |
| Padina japonica | | | | | | | | | | | |
| Padina tenuis | | | | | | | | | | | |
| Fam. Sargassaceae | | | | | | | | | | | |
| Turbinaria ornata | | | | | | | R | | | | |

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RHODOPHYTA (red) | | | | | | | | | | | |
| Fam. Acrochaetiaceae | | | | | | | | | | | |
| Acrochaetium sp. | | | | | | | | | | | |
| Fam. Bonnemaisoniaceae | | | | | | | | | | | |
| Asparagopsis taxiformis | | | | | | | | | | | |
| Fam. Chaetangiaceae | | | | | | | | | | | |
| Galaxaura filamentosa | | | | | | | | | | | |
| Galaxaura oblongata | | | | | | | | | | | |
| Fam. Gelidiaceae | | | | | | | | | | | |
| Gelidiella acerosa | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | C | | | C | |
| Gelidium pusillum | | | | | | | | | | | |
| Gracilaria salicornia | | | | | | | | | | | |
| Gracilaria sp. | | | | | | | | | | | |
| Fam. Gracilariaceae | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | | | | |
| Fam. Corallinaceae | | | | | | | | | | | |
| Actinotrichia fragilis | | | | | | | | | | | |
| Amphiroa fragilissima | | | | | | | | | | | |
| Amphiroa sp. | | | | | | | | | | | |
| Jania capillacea | | | | | | | | | | | |
| Lithothamnion sp. | | | | | | | | | | | |
| Neogoniolithon frutescens | | | | | | | | | | | |
| Porolithon gardineri | | | | | | | | | | | |
| Porolithon onkodes | | | | | | | | | | | |
| Fam. Cryptonemiaceae | | | | | | | | | | | |
| Halymenia sp. | | | | | | | | | | | |
| Fam. Peyssonneliaceae | | | | | | | | | | | |
| Peyssonnelia rubra | | | | | | | | | | | |
| Fam. Hypneaceae | | | | | | | | | | | |
| Hypnea esperi | | | | | | | | | | | |
| Hypnea pannosa | | | | | | | C | | | | |
| Fam. Ceramiaceae | | | | | | | | | | | |
| Centroceras clavulatum | | | | | | | | | | | |
| Ceramium sp. 1 | | | | | | | | | | | |
| Ceramium sp. 2 | | | | | | | | | | | |
| Herposiphonia tenella | | | | | | | | | | | |
| Polysiphonia scopulorum | | | | | | | | | | | |
| Polysiphonia sp. | | | | | | | | | | | |
| Polysiphonia spp. | | | | | | | C | | | C | |
| Spyridia filamentosa | | | | | | | | | | | |
| Tolypiocladia glomerulata | | | | | | | | | | | |
| Wrangelia sp. | | | | | | | | | | | |
| Fam. Delesseriaceae | | | | | | | | | | | |
| Martensia fragilis | | | | | | | | | | | |
| Fam. Rhodomelaceae | | | | | | | | | | | |
| Laurencia papillosa | | | | | | | | | | | |
| Laurencia parvipapillata | | | | | | | | | | | |
| Laurencia sp. | | | | | | | | | | | |
| Neo_ lith . | | | | | | | C | | | C | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | SECTION 4 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALGAE | | | | | | | | | | | | | | | |
| ANTHOPHYTA | | | | | | | | | | | | | | | |
| Cymodocea rotundata | | C | C | | | R | R | | | | | | | | |
| Enhalus acoroides | | C | C | | | C | | | | | | | | R | |
| Thalassia hemprichii | | A | A | | | C | | | | | C | | | C | |
| CYANOPHYTA (blue-green) | | | | | | | | | | | | | | | |
| Fam. Chamaesiphonaceae | | | | | | | | | | | | | | | |
| Entophysalis sp. | | | | | | | | | | | | | | | |
| Fam. Nostocaceae | | | | | | | | | | | | | | | |
| Calothrix scopulorum | | | | | | | | | | | | | | | |
| Hormothamnion enteromorphoides | | | | | | | | | | | | | | | |
| Fam. Oscillatoriaceae | | | | | | | | | | | | | | | |
| Microcoleus lyngbyaceus | | | | | | | | R | R | | | | | | |
| Schizothrix calcicola | | | | | | | | | | | | | | | |
| Schizothrix mexicana | | | | | | | | | | | | | | | |
| Fam. Unknown | | | | | | | | | | | | | | | |
| blue-green algae | | | | | | | | | | | | | | | |
| CHLOROPHYTA (green) | | | | | | | | | | | | | | | |
| Fam. Ulvaceae | | | | | | | | | | | | | | | |
| Avrainvillea obscura | | | | | | | | | | | | | | | |
| Enteromorpha clathrata | | | | | | | | | | | | | | | |
| Fam. Bryopsidaceae | | | | | | | | | | | | | | | |
| Bryopsis pennata | | | | | | | | | | | | | | | |
| Fam. Caulerpaceae | | | | | | | | | | | | | | | |
| Caulerpa cupressoides | | | | | | | | | | | | | | | |
| Caulerpa peltata | | | | | | | | | | | | | | | |
| Caulerpa racemosa | | C | | | | C | R | | | | C | | | R | |
| Caulerpa serrulata | | | | | | R | | | | | | | | | |
| Caulerpa sertularioides | | | | | | | | | | | | | | | |
| Caulerpa taxifolia | | | | | | | | | | | | | | | |
| Caulerpa urvilliana | | | | | | | | | | | | | | | |
| Caulerpa verticillata | | | | | | | | | | | | | | | |
| Fam. Codiaceae | | | | | | | | | | | | | | | |
| Chlorodesmis fastigiata | | | | | | | | | | | | | | | |
| Chlorodesmis sp. | | | | | | | | | | | | | | | |
| Cladophora sp. | | | | | | | | | | | | | | | |
| Codium arabicum | | | | | | | | | | | | | | | |
| Codium edule | | | | | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | | | | | |
| Halimeda cylindracea | | | | | | | | | | | | | | | |
| Halimeda discoidea | | | | | | | | | C | | | | | | |
| Halimeda gigas | | | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Halimeda incrassata | | | | | | | | | | | | | | | |
| Halimeda macroloba | | | C | | | | | | | | | | | | |
| Halimeda macrophysa | | | | | | | | | | | | | | | |
| Halimeda opuntia | | | C | | | C | | | | | | | | C | |
| Halimeda sp. | | | | | | | | | | | | | | | |
| Halimeda taenicola | | | | | | | | | | | | | | | |
| Rhipilia sp. | | | | | | | | | | | | | | | |
| Tydemania expeditionis | | | | | | | | | | | | | | | |
| Udotea indica | | | | | | | | | | | | | | | |
| Fam. Boodleaceae | | | | | | | | | | | | | | | |
| Boodlea composita | | | | | | | | | | | | | | | |
| Fam. Siphonocladaceae | | | | | | | | | | | | | | | |
| Cladophoropsis sp. | | | | | | | | | | | | | | | |
| Fam. Valoniaceae | | | | | | | | | | | | | | | |
| Dictyosphaeria cavernosa | | | | | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | | | | | |
| Valonia aegagropila | | | | | | | | | | | | | | | |
| Valonia fastigiata | | | | | | | | | | | | | | | |
| Valonia ventricosa | | | | | | | | | | | | | | | |
| Fam. Dasycladaceae | | | | | | | | | | | | | | | |
| Acetabularia moebii | | | | | | | | | | | | | | | |
| Neomeris annulata | | | | | | | | | | | | | | | |
| Neomeris vanbosseae | | | | | | | | | | | | | | | |
| Fam. Anadyomenaceae | | | | | | | | | | | | | | | |
| Microdictyon okamurai | | | | | | | | | | | | | | | |
| Fam. Cladophoraceae | | | | | | | | | | | | | | | |
| Chaetomorpha sp. | | | | | | | | | | | | | | | |
| Cladophora fascicularis | | | | | | | | | | | | | | | |
| PHAEOPHYTA (brown) | | | | | | | | | | | | | | | |
| Fam. Ectocarpaceae | | | | | | | | | | | | | | | |
| Ectocarpus breviarticulatus | | | | | | | | | | | | | | | |
| Feldmannia indica | | | | | | | | | | | | | | | |
| Fam. Ralfsiaceae | | | | | | | | | | | | | | | |
| Ralfsia occidentalis | | | | | | | | | | | | | | | |
| Fam. Sphacelariaceae | | | | | | | | | | | | | | | |
| Sphacelaria tribuloides | | | | | | | | | | | | | | | |
| Sphacelaria sp. | | | | | | | | | | | | | | | |
| Fam. Dictyotaceae | | | | | | | | | | | | | | | |
| Dictyopteris repens | | | | | | | | | | | | | | | |
| Dictyota bartayresii | | | | | | | | | | | | | | | |
| Dictyota divaricata | | | | | | | | | | | | | | | |
| Dictyota friabilis | | | | | | | | | | | | | | | |
| Lobophora variegata | | | | | | | | | | | | | | | |
| Padina japonica | | | | | | | | | | | | | | | |
| Padina tenuis | | | | | | C | | | | | C | | | | |
| Fam. Sargassaceae | | | | | | | | | | | | | | | |
| Turbinaria ornata | | | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RHODOPHYTA (red) | | | | | | | | | | | | | | | |
| Fam. Acrochaetiaceae | | | | | | | | | | | | | | | |
| Acrochaetium sp. | | | | | | | | | | | | | | | |
| Fam. Bonnemaisoniaceae | | | | | | | | | | | | | | | |
| Asparagopsis taxiformis | | | | | | | | | | | | | | | |
| Fam. Chaetangiaceae | | | | | | | | | | | | | | | |
| Galaxaura filamentosa | | | | | | | | | | | | | | | |
| Galaxaura oblongata | | | | | | | | | | | | | | | |
| Fam. Gelidiaceae | | | | | | | | | | | | | | | |
| Gelidiella acerosa | | | | | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | | | | | | | | |
| Gelidium pusillum | | | | | | | | | | | | | | | |
| Gracilaria salicornia | | C | C | | | R | | | | | | | | | |
| Gracilaria sp. | | | | | | R | | | | | | | | | |
| Fam. Gracilariaceae | | | | | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | | | | | | | | |
| Fam. Corallinaceae | | | | | | | | | | | | | | | |
| Actinotrichia fragilis | | | | | | | | | | | | | | | |
| Amphiroa fragilissima | | | | | | | | | | | | | | | |
| Amphiroa sp. | | | | | | | | | | | | | | | |
| Jania capillacea | | | | | | | | | | | | | | | |
| Lithothamnion sp. | | | | | | | | | | | | | | | |
| Neogoniolithon frutescens | | | | | | | | | | | | | | | |
| Porolithon gardineri | | | | | | | | | | | | | | | |
| Porolithon onkodes | | | | | | | | | | | | | | | |
| Fam. Cryptonemiaceae | | | | | | | | | | | | | | | |
| Halymenia sp. | | | | | | | | | | | | | | | |
| Fam. Peyssonneliaceae | | | | | | | | | | | | | | | |
| Peyssonelia rubra | | | | | | | | | | | | | | | |
| Fam. Hypneaceae | | | | | | | | | | | | | | | |
| Hypnea esperi | | | C | | | | | | | | | | | | |
| Hypnea pannosa | | | | | | | | | | | | | | | |
| Fam. Ceramiaceae | | | | | | | | | | | | | | | |
| Centroceras clavulatum | | | | | | | | | | | | | | | |
| Ceramium sp. 1 | | | | | | | | | | | | | | | |
| Ceramium sp. 2 | | | | | | | | | | | | | | | |
| Herposiphonia tenella | | | | | | | | | | | | | | | |
| Polysiphonia scopulorum | | | | | | | | | | | | | | | |
| Polysiphonia sp. | | | | | | | | | | | | | | | |
| Polysiphonia spp. | | | | | | | R | | | | | | | | |
| Spyridia filamentosa | | | | | | | | | | | | | | | |
| Tolypiocladia glomerulata | | | | | | | | | | | | | | | |
| Wrangelia sp. | | | | | | | | | | | | | | | |
| Fam. Delesseriaceae | | | | | | | | | | | | | | | |
| Martensia fragilis | | | | | | | | | | | | | | | |
| Fam. Rhodomelaceae | | | | | | | | | | | | | | | |
| Laurencia papillosa | | | | | | | | | | | | | | | |
| Laurencia parvipapillata | | | | | | | | | | | | | | | |
| Laurencia sp. | | | | | | | | | | | | | | | |
| Neogoniolithon sp. | | | | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ALGAE | | | | | | | | | | | |
| ANTHOPHYTA | | | | | | | | | | | |
| Cymodocea rotundata | | | | | | C | | | | | A |
| Enhalus acoroides | | | A | | | | | | | | A |
| Thalassia hemprichii | | | A | | | C | | | | | A |
| CYANOPHYTA (blue-green) | | | | | | | | | | | |
| Fam. Chamaesiphonaceae | | | | | | | | | | | |
| Entophysalis sp. | | | | | | | | | | | |
| Fam. Nostocaceae | | | | | | | | | | | |
| Calothrix scopulorum | | | | | | | | | | | |
| Hormothamnion enteromorphoides | | | | | | | | R | | | |
| Fam. Oscillatoriaceae | | | | | | | | | | | |
| Microcoleus lyngbyaceus | | | | | | | | C | | | |
| Schizothrix calcicola | | | | | | | | | | | |
| Schizothrix mexicana | | | | | | | | | | | |
| Fam. Unknown | | | | | | | | | | | |
| blue-green algae | | | | | | | | | | | |
| CHLOROPHYTA (green) | | | | | | | | | | | |
| Fam. Ulvaceae | | | | | | | | | | | |
| Avrainvillea obscura | | | | | | R | | | | | |
| Enteromorpha clathrata | | | | | | | | | | | |
| Fam. Bryopsidaceae | | | | | | | | | | | |
| Bryopsis pennata | | | | | | | | | | | |
| Fam. Caulerpaceae | | | | | | | | | | | |
| Caulerpa cupressoides | | | | | | | | | | | R |
| Caulerpa peltata | | | | | | | | | | | |
| Caulerpa racemosa | | R | C | | | | | | | | R |
| Caulerpa serrulata | | | | | | | | | | | |
| Caulerpa sertularioides | | | | | | | | | | | |
| Caulerpa taxifolia | | | | | | | | | | | |
| Caulerpa urvilliana | | | | | | | | | | | |
| Caulerpa verticillata | | | | | | | | | | | |
| Fam. Codiaceae | | | | | | | | | | | |
| Chlorodesmis fastigiata | | | | | | | | R | | | |
| Chlorodesmis sp. | | | | | | | | | | | |
| Cladophora sp. | | | | | | C | | | | | |
| Codium arabicum | | | | | | | | | | | |
| Codium edule | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | R | | | |
| Halimeda cylindracea | | | | | | | | | | | |
| Halimeda discoidea | | | | | | | | C | | | |
| Halimeda gigas | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 5 | | | | | | | SECTION 6 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a | |
| Halimeda incrassata | | | | | | | | | | | R | |
| Halimeda macroloba | | | | | | C | | | | | R | |
| Halimeda macrophysa | | | | | | | | C | | | | |
| Halimeda opuntia | | | | | | | | C | | | | |
| Halimeda sp. | | | | | | | | | | | | |
| Halimeda taenicola | | | | | | | | | | | | |
| Rhipilia sp. | | | | | | | | | | | | |
| Tydemania expeditionis | | R | | | | | | | | | | |
| Udotea indica | | | | | | | | | | | | |
| Fam. Boodleaceae | | | | | | | | | | | | |
| Boodlea composita | | | | | | | | | | | | |
| Fam. Siphonocladaceae | | | | | | | | | | | | |
| Cladophoropsis sp. | | | | | | | | | | | | |
| Fam. Valoniaceae | | | | | | | | | | | | |
| Dictyosphaeria cavernosa | | | | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | | | | |
| Valonia aegagropila | | | | | | | | | | | | |
| Valonia fastigiata | | | R | | | | | | | | | |
| Valonia ventricosa | | | | | | | | | | | | |
| Fam. Dasycladaceae | | | | | | | | | | | | |
| Acetabularia moebii | | | | | | | | | | | | |
| Neomeris annulata | | | | | | | | | | | | |
| Neomeris vanbosseae | | | | | | | | | | | | |
| Fam. Anadyomenaceae | | | | | | | | | | | | |
| Microdictyon okamurai | | | | | | | | | | | | |
| Fam. Cladophoraceae | | | | | | | | | | | | |
| Chaetomorpha sp. | | | R | | | C | | | | | | |
| Cladophora fascicularis | | | | | | | | | | | | |
| PHAEOPHYTA (brown) | | | | | | | | | | | | |
| Fam. Ectocarpaceae | | | | | | | | | | | | |
| Ectocarpus breviarticulatus | | | | | | | | | | | | |
| Feldmannia indica | | | | | | | | | | | | |
| Fam. Ralfsiaceae | | | | | | | | | | | | |
| Ralfsia occidentalis | | | | | | | | | | | | |
| Fam. Sphacelariaceae | | | | | | | | | | | | |
| Sphacelaria tribuloides | | | | | | | | | | | | |
| Sphacelaria sp. | | | | | | | | | | | | |
| Fam. Dictyotaceae | | | | | | | | | | | | |
| Dictyopteris repens | | | | | | | | | | | | |
| Dictyota bartayresii | | | | | | | | | | | | |
| Dictyota divaricata | | | | | | | | | | | | |
| Dictyota friabilis | | | | | | | | | | | | |
| Lobophora variegata | | | | | | | | | | | | |
| Padina japonica | | | | | | | | | | | | |
| Padina tenuis | | | | | | | | | | | | |
| Fam. Sargassaceae | | | | | | | | | | | | |
| Turbinaria ornata | | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YORI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RHODOPHYTA (red) | | | | | | | | | | | |
| Fam. Acrochaetiaceae | | | | | | | | | | | |
| Acrochaetium sp. | | | | | | | | | | | |
| Fam. Bonnemaisoniaceae | | | | | | | | | | | |
| Asparagopsis taxiformis | | | | | | | | | | | |
| Fam. Chaetangiaceae | | | | | | | | | | | |
| Galaxaura filamentosa | | | | | | | | | | | |
| Galaxaura oblongata | | | | | | | | | | | |
| Fam. Gelidiaceae | | | | | | | | | | | |
| Gelidiella acerosa | | | | | | | | | | | |
| Gelidiopsis intricata | | C | | | | | | | | | |
| Gelidium pusillum | | | | | | | | | | | |
| Gracilaria salicornia | | | A | | | C | | | | | A |
| Gracilaria sp. | | | | | | C | | | | | A |
| Fam. Gracilariaceae | | | | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | | | | |
| Fam. Corallinaceae | | | | | | | | | | | |
| Actinotrichia fragilis | | | | | | | | | | | |
| Amphiroa fragilissima | | | | | | | | | | | |
| Amphiroa sp. | | | | | | | | | | | |
| Jania capillacea | | | | | | | | | | | |
| Lithothamnion sp. | | | | | | | | | | | |
| Neogoniolithon frutescens | | | | | | | | | | | |
| Porolithon gardineri | | | | | | | | | | | |
| Porolithon onkodes | | | | | | | | | | | |
| Fam. Cryptonemiaceae | | | | | | | | | | | |
| Halymenia sp. | | | | | | | | | | | |
| Fam. Peyssonneliaceae | | | | | | | | | | | |
| Peyssonnelia rubra | | | | | | | | | | | |
| Fam. Hypneaceae | | | | | | | | | | | |
| Hypnea esperi | | | | | | | | | | | |
| Hypnea pannosa | | | | | | | | | | | |
| Fam. Ceramiaceae | | | | | | | | | | | |
| Centroceras clavulatum | | | | | | | | | | | |
| Ceramium sp. 1 | | | | | | | | | | | |
| Ceramium sp. 2 | | | | | | | | | | | |
| Herposiphonia tenella | | | | | | | | | | | |
| Polysiphonia scopulorum | | | | | | | | | | | |
| Polysiphonia sp. | | | | | | | | | | | |
| Polysiphonia spp. | | C | | | | | | | | | |
| Spyridia filamentosa | | | | | | | | | | | |
| Tolypiocladia glomerulata | | | | | | | | | | | |
| Wrangelia sp. | | | | | | | | | | | |
| Fam. Delesseriaceae | | | | | | | | | | | |
| Martensia fragilis | | | | | | | | | | | |
| Fam. Rhodomelaceae | | | | | | | | | | | |
| Laurencia papillosa | | | | | | | | | | | |
| Laurencia parvipapillata | | | | | | | | | | | |
| Laurencia sp. | | | | | | | | | | | |
| Neog[illegible]ithon | | | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 7 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| ALGAE | | | | | | | | |
| ANTHOPHYTA | | | | | | | | |
| Cymodocea rotundata | | | | | | | | |
| Enhalus acoroides | | | | | | | | |
| Thalassia hemprichii | | | | | | | | |
| CYANOPHYTA (blue-green) | | | | | | | | |
| Fam. Chamaesiphonaceae | | | | | | | | |
| Entophysalis sp. | | | | | | | | |
| Fam. Nostocaceae | | | | | | | | |
| Calothrix scopulorum | | | | | | | | |
| Hormothamnion enteromorphoides | | | | | | | | |
| Fam. Oscillatoriaceae | | | | | | | | |
| Microcoleus lyngbyaceus | R | R | | | | R | | |
| Schizothrix calcicola | | | | | | | | |
| Schizothrix mexicana | | | | | | | | |
| Fam. Unknown | | | | | | | | |
| blue-green algae | | | | | | | | |
| CHLOROPHYTA (green) | | | | | | | | |
| Fam. Ulvaceae | | | | | | | | |
| Avrainvillea obscura | | | | | | | | |
| Enteromorpha clathrata | | | | | | | | |
| Fam. Bryopsidaceae | | | | | | | | |
| Bryopsis pennata | | | | | | | | |
| Fam. Caulerpaceae | | | | | | | | |
| Caulerpa cupressoides | | | | | | | | |
| Caulerpa peltata | | | | | | | | |
| Caulerpa racemosa | | | | C | | | C | |
| Caulerpa serrulata | | | | | | | | |
| Caulerpa sertularioides | | | | | | | | |
| Caulerpa taxifolia | | | | | | | | |
| Caulerpa urvilliana | | | | | | | | |
| Caulerpa verticillata | | | | | | | | |
| Fam. Codiaceae | | | | | | | | |
| Chlorodesmis fastigiata | | | | | | | R | |
| Chlorodesmis sp. | | | | | | | | |
| Cladophora sp. | | | | | | | | |
| Codium arabicum | | | | | | | | |
| Codium edule | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | |
| Halimeda cylindracea | | | | | | | | |
| Halimeda discoidea | R | R | | | | | C | |
| Halimeda gigas | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 7 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c | |
| Halimeda incrassata | | | | | | | | | |
| Halimeda macroloba | | | | | | | | | |
| Halimeda macrophysa | | | | | | | R | | |
| Halimeda opuntia | | R | | C | | | | | |
| Halimeda sp. | | | | | | | | | |
| Halimeda taenicola | | | | | | | | | |
| Rhipilia sp. | | | | | | | | | |
| Tydemania expeditionis | | | | | | | R | | |
| Udotea indica | | | | | | | | | |
| Fam. Boodleaceae | | | | | | | | | |
| Boodlea composita | | | | | | | | | |
| Fam. Siphonocladaceae | | | | | | | | | |
| Cladophoropsis sp. | | | | | | | | | |
| Fam. Valoniaceae | | | | | | | | | |
| Dictyosphaeria cavernosa | | | | | | | | | |
| Dictyosphaeria versluysii | | | | | | | | | |
| Valonia aegagropila | | | | | | | | | |
| Valonia fastigiata | | R | | | | | | | |
| Valonia ventricosa | | R | | | | | | | |
| Fam. Dasycladaceae | | | | | | | | | |
| Acetabularia moebii | | | | | | | | | |
| Neomeris annulata | | | | | | | | | |
| Neomeris vanbosseae | | | | | | | | | |
| Fam. Anadyomenaceae | | | | | | | | | |
| Microdictyon okamurai | | | | | | | | | |
| Fam. Cladophoraceae | | | | | | | | | |
| Chaetomorpha sp. | | | | | | | | | |
| Cladophora fascicularis | | | | | | | | | |
| PHAEOPHYTA (brown) | | | | | | | | | |
| Fam. Ectocarpaceae | | | | | | | | | |
| Ectocarpus breviarticulatus | | | | | | | | | |
| Feldmannia indica | | | | | | | | | |
| Fam. Ralfsiaceae | | | | | | | | | |
| Ralfsia occidentalis | | | | | | | | | |
| Fam. Sphacelariaceae | | | | | | | | | |
| Sphacelaria tribuloides | | | | | | | | | |
| Sphacelaria sp. | | | | | | | | | |
| Fam. Dictyotaceae | | | | | | | | | |
| Dictyopteris repens | | | | | | | | | |
| Dictyota bartayresii | | | | | | | | | |
| Dictyota divaricata | | | | | | | | | |
| Dictyota friabilis | | R | | | | | | | |
| Lobophora variegata | | | | | | | | | |
| Padina japonica | | | | | | | | | |
| Padina tenuis | | | | | | | | | |
| Fam. Sargassaceae | | | | | | | | | |
| Turbinaria ornata | | | | | | | | | |

Appendix A
(cont'd)

Conspicuous algae species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 16a | 16b | 16d | SECTION 7 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| RHODOPHYTA (red) | | | | | | | | |
| Fam. Acrochaetiaceae | | | | | | | | |
| Acrochaetium sp. | | | | | | | | |
| Fam. Bonnemaisoniaceae | | | | | | | | |
| Asparagopsis taxiformis | | | | | | | | |
| Fam. Chaetangiaceae | | | | | | | | |
| Galaxaura filamentosa | | | | | | | | |
| Galaxaura oblongata | | | | | | | | |
| Fam. Gelidiaceae | | | | | | | | |
| Gelidiella acerosa | | | | | | | | |
| Gelidiopsis intricata | C | C | | C | | C | | |
| Gelidium pusillum | | | | | | | | |
| Gracilaria salicornia | | | | | | | | |
| Gracilaria sp. | | | | | | | | |
| Fam. Gracilariaceae | | | | | | | | |
| Gelidiopsis intricata | | | | | | | | |
| Fam. Corallinaceae | | | | | | | | |
| Actinotrichia fragilis | R | | | | | | | |
| Amphiroa fragilissima | | | | | | | R | |
| Amphiroa sp. | | | | | | | | |
| Jania capillacea | | | | | | | | |
| Lithothamnion sp. | | | | | | | | |
| Neogoniolithon frutescens | | | | | | | | |
| Porolithon gardineri | | | | | | | | |
| Porolithon onkodes | | | | | | | | |
| Fam. Cryptonemiaceae | | | | | | | | |
| Halymenia sp. | | | | | | | | |
| Fam. Peyssoneliaceae | | | | | | | | |
| Peyssonelia rubra | | | | | | | | |
| Fam. Hypneaceae | | | | | | | | |
| Hypnea esperi | | | | | | | | |
| Hypnea pannosa | R | | | C | | | C | |
| Fam. Ceramiaceae | | | | | | | | |
| Centroceras clavulatum | | | | | | | | |
| Ceramium sp. 1 | | | | | | | | |
| Ceramium sp. 2 | | | | | | | | |
| Herposiphonia tenella | | | | | | | | |
| Polysiphonia scopulorum | | | | | | | | |
| Polysiphonia sp. | | | | | | | | |
| Polysiphonia spp. | C | C | | C | | C | | |
| Spyridia filamentosa | | | | | | | | |
| Tolypiocladia glomerulata | | | | | | | | |
| Wrangelia sp. | | | | | | | | |
| Fam. Delesseriaceae | | | | | | | | |
| Martensia fragilis | | | | | | | | |
| Fam. Rhodomelaceae | | | | | | | | |
| Laurencia papillosa | | | | | | | | |
| Laurencia parvipapillata | | | | | | | | |
| Laurencia sp. | | | | | | | | |
| Neogoniolithon sp. | | | | | | | | |

Appendix B

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | YAP ISLANDS SPECIES LIST SECTION 1 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b | |
| FISH | | | | | | | | | | | | | | |
| PHYLUM CHORDATA | | | | | | | | | | | | | | |
| Fam. Carcharhinidae | | | | | | | | | | | | | | |
| Carcharhinus albimarginatus | | | | | | | | | | | | | | |
| Carcharhinus amblyrhynchos | | R | R | | | | | | | | | | | |
| Carcharhinus melanopterus | | | | | | | | | | | | | | |
| Fam. Hemigaleidae | | | | | | | | | | | | | | |
| Triaenodon obesus | | | | | | | | | | | | | | |
| Fam. Orectolobidae | | | | | | | | | | | | | | |
| Nebrius concolor | | | | | | | | | | | | | | |
| Fam. Dasyatididae | | | | | | | | | | | | | | |
| Dasyatis kuhlii | | | | | | | | | | | | R | | |
| Stingray | | | | | | | | | | | | | | |
| Fam. Urolophidae | | | | | | | | | | | | | | |
| Urolophus sp. | | | | | | | R | | | | | | | |
| Fam. Mobulidae | | | | | | | | | | | | | | |
| Manta alfredi | | | | | | | | | | | | | | |
| Manta sp. | | R | | | | | | | | | | | | |
| Fam. Myliobatidae | | | | | | | | | | | | | | |
| Aetobatus narinari | | | | | | | | | | | | | | |
| Fam. Muraenidae | | | | | | | | | | | | | | |
| Echidna nebulosa | | | | | | | | | | | | | | |
| Gymnothorax javanicus | | | | | | | R | | | | | | | |
| Gymnothorax flavimarginatus | | | | | | | | | | | | R | | |
| Gymnothorax meleagris | | | | | | | | | | | | | | |
| Siderea picta | | | | | | | | | | | | | | |
| Fam. Clupeidae | | | | | | | | | | | | | | |
| Spratelloides delicatulus | | | | | | | C | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Fam. Synodontidae | | | | | | | | | | | | | |
| Saurida gracilis | | | | | | | | | | | | | |
| Synodus sp. | | | | | | | | | | | | | |
| Synodus variegatus | | | | | | | | | | | | | |
| Fam. Chanidae | | | | | | | | | | | | | |
| Chanos chanos | | | | | | | | | | | | | |
| Fam. Belonidae | | | | | | | | | | | | | |
| Platybelone argalus platyura | | | | | | | | | | | | | |
| Strongylura incisa | | | | | | | | | | | | | |
| Fam. Hemiramphidae | | | | | | | | | | | | | |
| Hemiramphus sp. | | | | | | | | | | | | | |
| Fam. Haemulidae | | | | | | | | | | | | | |
| Diagramma pictum | | | | | | | | | | | | | |
| Plectorhinchus chaetodontoides | | | | | | | | | R | | | | |
| Plectorhinchus gaterinoides | | | | | | | | | | | | | |
| Plectorhinchus goldmanni | | | | | | | | | R | | | | |
| Plectorhinchus orientalis | | | | | | | | | R | | | | |
| Plectorhinchus gibbosus | | O | | | | O | | | | | R | | |
| Plectorhinchus pictus | | O | C | | | | | | | | | | |
| Fam. Plotosidae | | | | | | | | | | | | | |
| Plotosus lineatus | | | | | | | | | | | | | |
| Fam. Holocentridae | | | | | | | | | | | | | |
| Myripristis adustus | | O | O | | | O | | | O | | O | | |
| Myripristis berndti | | O | O | | | O | | | | | | | |
| Myripristis kuntee | | | | | | | | | | | | | |
| Myripristis murdjan | | | | | | O | | | | | R | | |
| Myripristis violacea | | O | O | | C | O | O | | O | | | | |
| Neoniphon opercularis | | | | | | | | | | | | | |

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Neoniphon sammara | | | | O | R | | | | | | | | |
| Sargocentron caudimaculatum | | R | | | | | | | | | | | |
| Sargocentron diadema | | | | | | | O | | | | | O | |
| Sargocentron microstoma | | | | | | | | | | | | | |
| Sargocentron punctatissimum | | | | | | | | | | | | | |
| Sargocentron spiniferum | | | R | | O | | | | O | O | R | | |
| Fam. Aulostomidae | | | | | | | | | | | | | |
| Aulostomus chinensis | | | | R | | | R | | | | | | |
| Fam. Fistulariidae | | | | | | | | | | | | | |
| Fistularia commersonii | | | | | | | | | | | | | |
| Fam. Sygnathidae | | | | | | | | | | | | | |
| Corythoichthys intestinalis | | | | O | | | R | | | | | | |
| Fam. Scorpaenidae | | | | | | | | | | | | | |
| Pterois antennata | | | | | | | | | | | | | |
| Pterois volitans | | | | | | | | | | | | | |
| Fam. Caracanthidae | | | | | | | | | | | | | |
| Caracanthus maculatus | | | | | | | | | | | | | |
| Fam. Serranidae | | | | | | | | | | | | | |
| Cephalopholis argus | | O | R | | | O | | | R | | R | | |
| Cephalopholis urodeta | | | | | | | | | O | | O | | |
| Epinephelus fasciatus | | | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | | | |
| Epinephelus hexagonatus | | | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | | | |
| Epinephelus merra | | | | | | | | | | O | | O | |
| Epinephelus microdon | | | | | | | | | | | | | |
| Epinephelus sp. | | | | | | | R | | | | | | |
| Epinephelus tauvina | | | | | | | | | | | | | |
| Pseudanthias dispar | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YORI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Fam. Carangidae | | | | | | | | | | | | | |
| Carangoides orthagrammus | | | | | | | | | | | | | |
| Caranx melampygus | | | | | O | O | | | | O | | | |
| Caranx sexfasciatus | | | | | | | | | | R | | | |
| Gnathanodon speciosus | | | O | | | | | | | | | | |
| Trachinotus baillonii | | | | | | | | | | | | | |
| Trachinotus blochii | | | | | | | | | | | | | |
| Fam. Lutjanidae | | | | | | | | | | | | | |
| Aphareus furca | | R | O | | | O | | | O | | O | | |
| Aprion virescens | | | | | | | | | | | | | |
| Lutjanus bohar | | R | O | | O | | | | | | | | |
| Lutjanus ehrenbergi | | | | | | | | | | | | | |
| Lutjanus fulvus | | | | | | | | | | | | | |
| Lutjanus gibbus | | O | O | | C | | | | A | | A | | |
| Lutjanus kasmira | | | | | | | | | | | | | |
| Lutjanus monostigmus | | O | O | | | O | | | A | | R | | |
| Lutjanus rivulatus | | | | | | | | | R | | | | |
| Macolor niger | | O | O | | O | O | | | O | | | | |
| Fam. Caesionidae | | | | | | | | | | | | | |
| Caesio caerulaurea | | | | | | | | | | | | | |
| Caesio cuning | | | | | | | | | R | | | | |
| Caesio lunaris | | | | | | O | | | | | | | |
| Caesio teres | | | | | | | | | | | | | |
| Pterocaesio tile | | A | A | | | A | | | | | A | | |
| Caesio teres | | A | | | | C | | | | | | | |
| Pterocaesio marri | | | | | | | | | | | | | |
| Pterocaesio pisang | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Pseudanthias pascalus | | | A | | | | | | | | | | |
| Plectropomus laevis | | | | | | | | | | | | | |
| Plectropomus areolatus | | | | | | | | | | | | | |
| Variola louti | | | | | | | | | | | | | |
| Fam. Pseudochromidae | | | | | | | | | | | | | |
| Pseudochromis sp. | | | | | | | | | | | | | |
| Fam. Cirrhitidae | | | | | | | | | | | | | |
| Paracirrhitus arcatus | R | | | | | R | | | | | | | |
| Paracirrhitus forsteri | | | | | | | | | | | | | |
| Fam. Kuhliidae | | | | | | | | | | | | | |
| Kuhlia mugil | | | | | | | | | | | | | |
| Fam. Grammistidae | | | | | | | | | | | | | |
| Belanoperca chaubanaudi | | | | | | | | | | | | | |
| Fam. Apogonidae | | | | | | | | | | | | | |
| Apogon amboinensis | | | | | | | | | | | | | |
| Apogon cyanosoma | | | | | | | | | | | | | |
| Apogon sp. cf A. sangiensis | | | | | | | | | | | | | |
| Apogon sp. cf A. exostigma | A | | | | | | | | | | | | |
| Apogon fraenatus | | | | | | | | | | | | | |
| Apogon leptacanthus | | | | | | | | | | | | O | |
| Apogon novemfasciatus | | | | | | | | | | | | | |
| Archamia fucata | | | | | | | | | | | | | |
| Archamia zosterophora | | | | | | | | | | | | | |
| Cheilodipterus macrodon | | | | | | | | | | | | | |
| Cheilodipterus quinquelineata | O | | | | O | | | | | O | | O | |
| Sphaeramia nematoptera | | | | | | | | | | | | | |
| Sphaeramia orbicularis | | | | | | | | | | | | | |
| Fam. Malacanthidae | | | | | | | | | | | | | |
| Malacanthus latovittatus | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Fam. Lethrinidae | | | | | | | | | | | | | |
| Gnathodentex aureolineatus | | | | | C | | C | | | | | | |
| Lethrinus amboinensis | | | | | | | | | | | | | |
| Lethrinus harak | | | | | R | | R | | | R | | | |
| Lethrinus elongatus | | | | | | | | | | | | | |
| Lethrinus semicinctus | | | | | | | | | | | | | |
| Lethrinus ornatus | | | | | | | | | | | | | |
| Lethrinus sp. | R | | | | | | R | | | | | | |
| Monotaxis grandoculis | | O | C | | | | O | | O | O | C | | |
| Fam. Nemipteridae | | | | | | | | | | | | | |
| Pentapodus macrurus | | | | | | | | | | | | | |
| Scolopsis bilineatus | | | | | | | | | | | | | |
| Scolopsis lineatus | | | | | | | | | | | | | |
| Scolopsis ciliatus | R | | | | | | | | | | | | |
| Scolopsis cf. xenochrous | R | | | | | | | | | R | | R | |
| Scolopsis trilineatus | | | | | | | | | | | | | |
| Fam. Gerreidae | | | | | | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | | | | | | |
| Fam. Mullidae | | | | | | | | | | | | | |
| Mulloides flavolineatus | C | O | | O | | | C | | | | | | |
| Mulloides vanicolensis | | | | | | | | | | | | | |
| Parupeneus barberinus | O | | | | | | O | | | R | | | |
| Parupeneus bifasciatus | | | R | R | | | | | | | R | | |
| Parupeneus ciliatus | | | | | | | | | | | | | |
| Parupeneus cyclostomus | | | | | O | | | | | | | | |
| Parupeneus indicus | | R | | | | | | | | | | | |
| Parupeneus multifasciatus | O | | O | | O | R | O | | | | O | | |
| Parupeneus pleurostigma | | | | | | | | | | | | | |
| Parupeneus sp. | | | | | | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | | | | | | |
| Upeneus vittatus | | | | | | | O | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Fam. Kyphosidae | | | | | | | | | | | | | |
| Kyphosus cinerascens | | | | | O | | | | C | | | | |
| Kyphosus lembus | | | | | | | | | | | | | |
| Kyphosus sp. | | | | | | | | | | | | | |
| Kyphosus vaigiensis | | | | | | | | | | | | | |
| Fam. Ephippidae | | | | | | | | | | | | | |
| Platax orbicularis | | | | | | | | | | | | | |
| Fam. Toxotidae | | | | | | | | | | | | | |
| Toxotes jactator | | | | | | | | | | | | | |
| Fam. Scatophagidae | | | | | | | | | | | | | |
| Scatophagus argus | | | | | | | | | | | | | |
| Fam. Chaetodontidae | | | | | | | | | | | | | |
| Chaetodon auriga | | | R | O | O | O | O | | | R | | R | |
| Chaetodon bennetti | | | | | | R | | | R | | | | |
| Chaetodon citrinellus | O | | | O | O | | | | R | | R | R | |
| Chaetodon ephippium | O | | | R | O | | R | | | | R | | |
| Chaetodon kleinii | | | | R | R | | O | | | | | | |
| Chaetodon lineolatus | | R | | | | O | | | | | | | |
| Chaetodon lunula | R | | | | | R | | | R | | | | |
| Chaetodon melannotus | O | | | O | | | | | O | | R | | |
| Chaetodon mertensii | | | R | | | | O | | | | | | |
| Chaetodon meyeri | | | | | | | | | | | | | |
| Chaetodon ornatissimus | | | | | | | | | R | | O | | |
| Chaetodon plebius | | | | | | | | | | | | | |
| Chaetodon punctatofasciatus | | O | O | | | O | | | O | | R | | |
| Chaetodon rafflesii | O | | O | | | | | | | | | | |
| Chaetodon reticulatus | O | O | O | | R | O | | | O | | O | | |
| Chaetodon semeion | | | | | | R | | | | | | | |
| Chaetodon trifascialis | O | O | R | O | O | O | R | | O | | O | | |
| Chaetodon trifasciatus | O | O | O | | O | | O | | | R | O | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — YAP ISLANDS SPECIES LIST SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Chaetodon ulietensis | | O | O | | R | O | O | | | | | | |
| Chaetodon unimaculatus | | R | | R | | O | | | R | | R | | |
| Chaetodon vagabundus | | | | | | | O | | O | | R | R | |
| Forcipiger flavissimus | | O | | | R | | O | | O | R | O | | |
| Forcipiger longirostris | | | R | | R | | | | R | | | | |
| Hemitaurichthys polylepis | | A | A | | | | | | A | | A | | |
| Heniochus acuminatus | | | | | | | | | | R | | | |
| Heniochus chrysostomus | | | | O | R | | | | | | O | | |
| Heniochus monoceros | | O | | | R | O | | | O | | R | | |
| Heniochus varius | | R | R | | | | | | | | O | | |
| Fam Pempheridídae | | | | | | | | | | | | | |
| Pempheris oualensis | | O | O | | | O | | | | | | | |
| Fam. Pomacanthidae | | | | | | | | | | | | | |
| Centropyge bicolor | | | | | | | | | | | | | |
| Centropyge bispinosus | | | R | | | | | | | | | | |
| Centropyge flavissimus | | | | | | | | | | | | | |
| Centropyge heraldi | | | | | | | | | | | | | |
| Centropyge loriculus | | | R | | | O | | | | | | | |
| Centropyge nox | | | | | | R | | | | | | | |
| Centropyge tibicen | | | | | | | | | | | | | |
| Centropyge vrolicki | | | | | | R | | | R | R | R | | |
| Pomacanthus imperator | | | R | | | | | | | | | | |
| Pomacanthus sextriatus | | | | | | | | | | | | | |
| Pomacanthus xanthometopon | | | | | | O | | | | R | | | |
| Pygoplites diacanthus | | R | | | | | | | | | R | | |
| Fam. Pomacentridae | | | | | | | | | | | | | |
| Abudefduf septemfasciatus | | | | | | | | | | | | | |
| Abudefduf sexfasciatus | | | | | R | | O | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Abudefduf sordidus | | | | | | | | | | | | | |
| Abudefduf sp. | | | | | | | | | | | | | |
| Abudefduf saxatilis | | | | | | | | | | | | | |
| Amblyglyphidodon aureus | | | | O | | | | | | | | | |
| Amblyglyphidodon curacao | R | | | O | C | | C | | | C | | O | |
| Amblyglyphidodon leucogaster | | O | O | | C | | O | | R | O | | | |
| Amblyglyphidodon ternatensis | | R | R | | | | | | | | | | |
| Amphiprion chrysopterus | | | | | | | | | | | | | |
| Amphiprion clarkii | | O | | | | O | | | O | | R | | |
| Amphiprion melanopus | R | | | | | | | | | R | | | |
| Amphiprion peridaeraion | | | R | | | | | | | | | | |
| Chromis agilis | | | | | | | | | | | | | |
| Chromis amboinensis | | | | | | | | | | | | | |
| Chromis atripectoralis | | | | | O | | | | | | | | |
| Chromis atripes | | A | | | | A | | | O | | | | |
| Chromis viridis | | | | C | C | | C | | | C | | C | |
| Chromis lepidolepis | | | | | C | | | | | | | | |
| Chromis margaritifer | O | | A | | O | A | | | A | | O | R | |
| Chromis phillipinus | | | | | | | | | | | | | |
| Chromis sp. | | | | | | | | | | | | | |
| Chromis ternatensis | | O | O | | | | | | | O | | | |
| Chromis vaiuli | | | | | | | | | | | | | |
| Chromis vanderbilti | | | | | | | | | | | | | |
| Chromis xanthura | | | R | | | | | | | | | | |
| Chrysiptera cyanea | | | | | | | | | | O | | | |
| Chrysiptera glauca | | | | | | | | | | | | | |
| Chrysiptera leucopoma | | | | C | | | | | | | | | |
| Chrysiptera traceyi | | | | | | | | | | | | | |
| Dascyllus aruanus | A | | | O | O | | C | | | O | | C | |
| Dascyllus melanurus | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Dascyllus reticulatus | | | | O | C | | | | | | O | | |
| Dascyllus trimaculatus | C | R | | | C | O | O | | O | O | R | O | |
| Dischistodus chrysopoecilus | | | | | | | | | | | | | |
| Dischistodus notopthalmus | | | | O | | | O | | | | | R | |
| Dischistodus perspicillatus | | | | O | | | O | | | | | R | |
| Hemiglyphidodon plagiometapon | | | | | | | O | | | | | | |
| Paraglyphidodon melas | | | | | | | | | | | | | |
| Plectroglyphidodon dickii | | O | O | | O | | | | | | O | | |
| Plectroglyphidodon johnstonianus | | | | | | | | | O | | | | |
| Plectroglyphidodon lacrymatus | | | O | | R | C | | | O | | O | | |
| Plectroglyphidodon leucozona | R | | | | | | | | | | | | |
| Pomacentrus bankanensis | | | | | | | | | | | | | |
| Pomacentrus coelestis | O | | | O | | | | | | | | | |
| Pomacentrus moluccensis | | | | | | | O | | | | | | |
| Pomacentrus grammorhynchus | | | | | | | | | | | | | |
| Pomacentrus pavo | O | | | | C | | | | | C | | C | |
| Pomancentrus phillipinus | | | | | | | | | | | | | |
| Pomacentrus sp. | | | | | | | | | | | | | |
| Pomacentrus vaiuli | | | | | | | | | | | O | | |
| Stegastes albifasciatus | | | | | | | | | | | | | |
| Stegastes fasciolatus | | | | | | | | | | | | | |
| Stegastes lividus | O | | | O | | | | | | | | | |
| Stegastes nigricans | C | | | C | | | C | | | | | O | |
| Fam. Mugilidae | | | | | | | | | | | | | |
| Liza vaigiensis | | | | | | | | | | | | | |
| Valamugil engeli | | | | | | | | | | | | | |
| Valamugil sp. or seheli | | | | | R | | | | | | | | |
| Fam. Sphyraenidae | | | | | | | | | | | | | |
| Sphyraena barracuda | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | | | | | | | YAP ISLANDS SPECIES LIST SECTION 1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
| FISH | | | | | | | | | | | | | |
| Fam. Labridae | | | | | | | | | | | | | |
| Anampses caeruleopunctatus | R | | | | | R | | | | | | | |
| Anampses melanurus | | | | | | | | | | | | | |
| Anampses meleagrides | | | | | | | | | | | | | |
| Anampses twisti | | R | | | R | O | O | | | | | | |
| Bodianus axillaris | | R | R | | | O | | | | | R | | |
| Bodianus bimaculatus or B.loxozona | | | | | | | | | | | | | |
| Cheilinus bimaculutus | | | | | | | | | | | | | |
| Cheilinus celebicus | | | | | | | | | | | | | |
| Cheilinus chlorourus | | | | | | | | | | | | | |
| Cheilinus digrammus | | | | | | | R | | R | R | | | |
| Cheilinus fasciatus | | R | | R | O | | O | | | R | | R | |
| Cheilinus trilobatus | | | | | R | | | | | | | | |
| Cheilinus undulatus | | | | O | | | O | | | | | R | |
| Cheilinus unifasciatus | | R | | | | O | R | | | | | | |
| Cheilio inermis | R | | | | | | R | | | | | | |
| Choerodon anchorago | | | R | | | | O | | | | | R | |
| Cirrhilabrus n.sp.2 | | | | | | | | | | | | | |
| Coris aygula | | | | | | | | | | | | | |
| Coris gaimardi | | | | | | | | | | | | | |
| Diproctaconthus xanthurus | | | | | | | | | | | | | |
| Epibulus insidiator | O | O | O | O | O | O | O | | | | O | O | |
| Gomphosus varius | O | O | O | | O | O | O | | O | | | | |
| Halichoeres biocellatus | | | R | | | | | | | | | | |
| Halichoeres chrysus | | | | | | | | | | | | | |
| Halichoeres chloropterus | | | | | | | | | | | | | |
| Halichoeres hortulanus | | R | O | | R | O | | | O | | R | | |
| Halichoeres margaritaceus | | | | | | | | | | | | | |
| Halichoeres sp. | | | | | | | | | | | | R | |
| Halichoeres marginatus | R | | | | O | | | | | | R | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Halichoeres melanurus | | | | | | | | | | | | | |
| Halichoeres prosopeion | | | | | | | | | | | | | |
| Halichoeres trimaculatus | C | | | | | | O | | | C | | O | |
| Hemigymnus fasciatus | | | | | | | R | | R | | | | |
| Hemigymnus melapterus | R | | | O | | | O | | R | | R | R | |
| Hologymnosus doliatus | | | | | | | | | | | R | | |
| Labrichthys unilineatus | | | | | O | | O | | | | | R | |
| Labroides bicolor | | | R | R | R | | O | | O | R | R | R | |
| Labroides dimidiatus | | O | | | O | O | R | | O | R | O | R | |
| Labroides pectoralis | | | | | | | | | | | | | |
| Labropsis xanthonota | | | R | | | R | | | | | | | |
| Labropsis micronesica | | | | | | | | | | | | | |
| Macropharyngodon meleagris | | | | | | | | | | | | | |
| Macropharyngodon negrosensis | | | | | | | | | | | | | |
| Novaculichthys taeniourus | | | | | | | | | | | | | |
| Pseudocheilinus evanidus | | | | | | | | | | | | | |
| Pseudocheilinus hexataenia | | | R | R | O | R | | | R | | R | O | |
| Stethojulis bandanensis | R | | | O | | | O | | | | | R | |
| Stethojulis strigiventor | | | | | | | | | | | | | |
| Stethojulis trilineata | | | | | O | | | | | | | | |
| Thalassoma amblycephalum | | | | | C | R | O | | | O | | O | |
| Thalassoma hardwickii | O | | | O | O | R | O | | | | R | R | |
| Thalassoma janseni | | | | | | | | | | | | | |
| Thalassoma lunare | | | | | | R | R | | | | | R | |
| Thalassoma lutescens | | R | O | | | O | | | R | | | | |
| Thalassoma purpureum | | | | | | | | | | | | | |
| Thalassoma quinquevittatum | | | | | | R | | | O | | | | |
| Thalassoma trilobatum | | | | | | | | | | | | | |
| Xyrichthys pavo | | | | | | | | | | | | | C |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | YAP ISLANDS SPECIES LIST SECTION 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
| FISH | | | | | | | | | | | | | |
| Fam. Scaridae | | | | | | | | | | | | | |
| Bolbometopon muricatum | | | | | | | | | | | | | |
| Calotomus carolinus sp.C.spinidens | | | | | | | | | | | | | |
| Cetoscarus bicolor | | | | | | O | | | R | | R | | |
| Leptoscarus vaigiensis | | | | | | | | | | | | | |
| Scarus altipinnis | | | | | | | | | | | | | |
| Scarus atropectoralis | | | | | | | | | | | | | |
| Scarus dimidiatus | O | | | O | O | | O | | | | | | |
| Scarus forsteni | | | | | | R | | | | | | | |
| Scarus frenatus | | | | | | | | | | | | | |
| Scarus frontalis | | | | | | | | | R | | | | |
| Scarus ghobban | | | | | | | O | | | | | | |
| Scarus gibbus | | R | | | | R | | | R | | | | |
| Scarus globiceps | | | | | R | | | | | | | | |
| Scarus javanicus | | | | | | | | | | | | | |
| Hipposcarus longiceps | | R | | | | | | | | | | | |
| Scarus niger | | R | O | | O | O | | | | | | | |
| Scarus oviceps | C | O | O | O | | | R | | O | R | O | R | |
| Scarus prasiognathus | | | | | | | | | | | | | |
| Scarus psittacus | | | | | | | | | O | | | | |
| Scarus quoyi | | | | | | | | | | | | | |
| Scarus rubroviolaceus | | | | | | | | | | | | | |
| Scarus schlegeli | R | | | | | | | | | | R | | |
| Scarus sordidus | | O | O | O | C | O | O | | O | | | R | |
| Scarus sp. (juv.) | | | | | | | | | | | | R | |
| Scarus spinus | | | R | R | | | | | | | R | | |
| Scarus spp. (adult) | | | | | O | | | | | | | | |
| Scarus spp. (juv.) | | | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Fam. Mugiloididae | | | | | | | | | | | | | |
| Parapercis millipunctata | | | | | | | | | | | | | |
| Parapercis clathrata | | | | | | | | | | | | | |
| Fam. Trichonotidae | | | | | | | | | | | | | |
| Trichonotus(?) | | | | | | | | | | C | | | |
| Fam. Blenniidae | | | | | | | | | | | | | |
| Aspidontus taeniatus | | | | R | R | | | | | | | | |
| Exalias brevis | | | | | | | | | | | | | |
| Istiblennius lineatus | | | | | | | | | | | | | |
| Meiacanthus atrodorsalis | | | | | O | | R | | | R | | R | |
| Meiacanthus grammistes | | | | | O | | | | | | | | |
| Plagiotremus rhynorhynchus | | | | | | | | | | | | | |
| Plagiotremus tapeinosoma | | | | | | | | | | | | | |
| Fam. Gobiidae | | | | | | | | | | | | | |
| Acentrogobius sp. | | | | | | | | | | | | O | |
| Amblygobius phalaena | | | | O | | | | | | | | | |
| Asterropteryx semipunctatus | | | | | | | | | | | | | |
| Bathygobius fuscus | | | | | | | | | | | | | |
| Bathygobius youngei | | | | | | | | | | | | | |
| Eviota sp. | | | | | | | | | | | | | |
| Exyrias puntang | | | | | | | | R | | | | | |
| Cryptocentrus sp. | | | | | | | | | | | | | |
| Goby sp. (with shrimp) | | | | | | | | | | | | R | |
| Goby sp. | | | | | | | | | | | | | |
| Gobiodon sp. cf. G. okinawae | | | | | | | | | | | | | |
| Istigobius rigilius | | | | | | | O | | | | | | |
| Oplopomus oplopomus | | | | | | | | | | | | | |
| Valenciennea strigatus | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | YAP ISLANDS SPECIES LIST SECTION 1 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | | |
| Fam. Microdesmidae | | | | | | | | | | | | | | |
| Nemateleotris magnifica | | | | | | O | | | | | | O | | |
| Ptereleotris evides | | | | | | | O | | | | | | | |
| Ptereleotris sp. | | | | | | | | | | | | | | |
| Ptereleotris tricolor | | | | | | | | | | | | | | |
| Fam. Callionymidae | | | | | | | | | | | | | | |
| Callionymus sp. | | | | | | | | | | | | | | |
| Fam. Acanthuridae | | | | | | | | | | | | | | |
| Acanthurus achilles | | | | | | | | | | | | | | |
| Acanthurus chronixis | | | | | | R | | | | | | | | |
| Acanthurus dussumieri | | | | | | | | | | | | | | |
| Acanthurus nigricans | | R | O | | O | O | C | O | | C | | C | | |
| Acanthurus guttatus | | | | | | | | | | | | | | |
| Acanthurus lineatus | | | | | O | O | | | | | | | | |
| Acanthurus blochii | | | R | | | | | O | | | O | | | |
| Acanthurus nigricauda | | | | | | C | | | | | | | | |
| Acanthurus nigrofuscus | | C | | | | | | C | | | | | | |
| Acanthurus nigroris | | | | | | | | | | | | | | |
| Acanthurus olivaceus | | | | | | | | | | | | | | |
| Acanthurus pyroferus | | | | | | | | R | | R | R | R | | |
| Acanthurus thompsoni | | | | O | | | | | | | | | | |
| Acanthurus triostegus | | O | | | A | | | C | | | | | | |
| Acanthurus xanthopterus | | C | | | O | O | O | O | | C | | O | R | |
| Ctenochaetus binotatus | | | | | | | | O | | | O | | O | |
| Ctenochaetus hawaiiensis | | | | | | | | | | | | C | | |
| Ctenochaetus striatus | | A | C | | C | C | C | O | | C | | | | |
| Ctenochaetus strigosus | | | | | | | | | | | | | | |
| Naso annulatus | | | | | | | | | | | | | | |
| Naso brevirostris | | | C | C | | | | | | | | | | |
| Naso hexacanthus | | | | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Naso lituratus | O | O | O | | O | | | | R | | R | | |
| Naso lopezi | | O | O | | | O | | | R | | | | |
| Naso thynnoides | | | | | | | | | | | | | |
| Naso tuberosus | | | C | | | C | | | | | | | |
| Naso unicornis | | | R | | | | | | | | | | |
| Naso vlamingii | | O | R | | | O | | | | | | | |
| Zebrasoma flavescens | | | R | | | | | | | | | | |
| Zebrasoma scopas | C | R | O | O | O | | O | | | | | O | |
| Zebrasoma veliferum | O | | R | O | O | | O | | | | | | |
| Fam. Zanclidae | | | | | | | | | | | | | |
| Zanclus cornutus | O | O | O | O | O | O | R | | O | R | O | | |
| Fam. Siganidae | | | | | | | | | | | | | |
| Siganus argenteus | | | | | | R | | | | | | | |
| Siganus corallinus | | | | | | | | | | | | | |
| Siganus canaliculatus | | | | | | | | | | | | | |
| Siganus doliatus | | | | | | | R | | | | | | |
| Siganus puellus | | | | | R | | R | | | | | | |
| Siganus vulpinus | | | | | | | | | | | O | | |
| Siganus lineatus | | | | | | | | | | O | | | |
| Siganus spinus | | | | | | | | | | | | | |
| Fam. Bothidae | | | | | | | | | | | | | |
| Bothus sp. | | | | | | | | | | | | | |
| Fam. Balistidae | | | | | | | | | | | | | |
| Balistapus undulatus | | R | R | | | O | | | O | | O | | |
| Balistoides conspicillum | | | | | | | | | | | | | |
| Balistoides viridescens | | R | | | | | | | | | | | |
| Melichthys niger | | | | | | O | | | O | | | | |
| Melichthys vidua | | R | O | | | | | | | | R | | |
| Pseudobalistes flavimarginatus | | | | | | | | | | | | | |
| Rhinecanthus aculeatus | O | | | | | | | | | O | | R | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

YAP ISLANDS SPECIES LIST
SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | | |
| Rhinecanthus rectangulus | | | | | | | | | | | | | |
| Rhinecanthus verrucosa | | | | | | | | | | | | | |
| Sufflamen bursa | | | | | | | | | | | | | |
| Sufflamen chrysoptera | | | | | | R | | | | | | | |
| Fam. Monacanthidae | | | | | | | | | | | | | |
| Aluterus scriptus | | | | | | | | | | | | | |
| Amanses scopas | | R | | | | | R | | | | | | |
| Cantherhines pardalis | | | | | | | | | | | | | |
| Cantherhines dumerilii | | | | | | | | | | | | | |
| Oxymonacanthus longirostris | | | O | | | | | | | | | | |
| Paraluteres prionurus | | | | | | | | | | | | | |
| Pervagor sp. | | | | | | | | | | | | | |
| Fam. Ostraciontidae | | | | | | | | | | | | | |
| Lactoria cornuta | | | | | | | | | | | | | |
| Ostracion cubicus | | | | | | | | | | | | | |
| Ostracion meleagris | | | | | R | | | | | | R | | |
| Fam. Tetraodontidae | | | | | | | | | | | | | |
| Arothron hispidus | | | | | | | | | | | | | |
| Arothron manilensis | | | | | | | | | | R | | R | |
| Arothron meleagris | | | | | | | | | | | | | |
| Arothron stellatus | | | | | | | | | | | | | |
| Canthigaster amboinensis | | | | | | | | | | | | | |
| Canthigaster bennetti | | | | | | | | | | | | | |
| Canthigaster solandri | | | | | | | | | | | | | |
| Canthigaster valentini | | | R | | | | | | | | | R | |
| Fam. Diodontidae | | | | | | | | | | | | | |
| Diodon hystrix | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Class Reptilia | | | | | | | | | | | | | |
| Order Testudines | | | | | | | | | | | | | |
| Fam. Cheloniidae | | | | | | | | | | | | | |
| Chelonia mydas | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| FISH | | | | | | | | | | | |
| PHYLUM CHORDATA | | | | | | | | | | | |
| Fam. Carcharhinidae | | | | | | | | | | | |
| Carcharhinus albimarginatus | | | | | | | | | | | |
| Carcharhinus amblyrhynchos | | | | | | | | | | | |
| Carcharhinus melanopterus | | | | | | | | | | | |
| Fam. Hemigaleidae | | | | | | | | | | | |
| Triaenodon obesus | | | | R | | | | | | | |
| Fam. Orectolobidae | | | | | | | | | | | |
| Nebrius concolor | | | | | | | | | | | |
| Fam. Dasyatididae | | | | | | | | | | | |
| Dasyatis kuhlii | | | | | | | | | | | |
| Stingray | | | | | | | | | | | |
| Fam. Urolophidae | | | | | | | | | | | |
| Urolophus sp. | | | | | | | | | | | |
| Fam. Mobulidae | | | | | | | | | | | |
| Manta alfredi | | | | | | | | | | | |
| Manta sp. | | | | | | | | | | | |
| Fam. Myliobatidae | | | | | | | | | | | |
| Aetobatus narinari | | | | | | | | | | | |
| Fam. Muraenidae | | | | | | | | | | | |
| Echidna nebulosa | | | | | | | | | | | |
| Gymnothorax javanicus | | | | | | | | | | | |
| Gymnothorax flavimarginatus | | | | | | | | | | | |
| Gymnothorax meleagris | | | | | | | | | | | |
| Siderea picta | | | | | | | | | | | |
| Fam. Clupeidae | | | | | | | | | | | |
| Spratelloides delicatulus | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Synodontidae | | | | | | | | | | | |
| Saurida gracilis | | | | | | | | | | | |
| Synodus sp. | | | | | | | | | | | |
| Synodus variegatus | | | | | | | | | | R | |
| Fam. Chanidae | | | | | | | | | | | |
| Chanos chanos | | | | | | | | | | | |
| Fam. Belonidae | | | | | | | | | | | |
| Platybelone argalus platyura | | | | | | | | | | | |
| Strongylura incisa | | | | | | | | | | | |
| Fam. Hemiramphidae | | | | | | | | | | | |
| Hemiramphus sp. | | | | | | | | | | | |
| Fam. Haemulidae | | | | | | | | | | | |
| Diagramma pictum | | | | | | | | | | | |
| Plectorhinchus chaetodontoides | | | | | | | | | | O | |
| Plectorhinchus gaterinoides | | | R | | | | | | | | |
| Plectorhinchus goldmanni | | | | | | | | | | | R |
| Plectorhinchus orientalis | | | | | | | | | | R | |
| Plectorhinchus gibbosus | | | | | | | | | | | O |
| Plectorhinchus pictus | | | | | | | | | | | |
| Fam. Plotosidae | | | | | | | | | | | |
| Plotosus lineatus | | | | | | | | | | | |
| Fam. Holocentridae | | | | | | | | | | | |
| Myripristis adustus | | R | | A | R | | | O | | | C |
| Myripristis berndti | | | O | | | | | O | | | |
| Myripristis kuntee | | | | | | | | | | | |
| Myripristis murdjan | | | | | | | | | | O | |
| Myripristis violacea | | | | O | | | | O | | | O |
| Neoniphon opercularis | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Neoniphon sammara | | | | | | O | | | | O | R |
| Sargocentron caudimaculatum | | | | | | | | | | | |
| Sargocentron diadema | | | | | | | | | | R | |
| Sargocentron microstoma | | | | | | | | | | | |
| Sargocentron punctatissimum | | | | | | | | | | R | |
| Sargocentron spiniferum | | R | | R | | | | | | | |
| Fam. Aulostomidae | | | | | | | | | | | |
| Aulostomus chinensis | | R | | | | | | | | | |
| Fam. Fistulariidae | | | | | | | | | | | |
| Fistularia commersonii | | | | | | | | | | | |
| Fam. Sygnathidae | | | | | | | | | | | |
| Corythoichthys intestinalis | | | | | | | | | | O | |
| Fam. Scorpaenidae | | | | | | | | | | | |
| Pterois antennata | | | | | | | | | | | |
| Pterois volitans | | | | | | | | | | R | |
| Fam. Caracanthidae | | | | | | | | | | | |
| Caracanthus maculatus | | | | | | | | | | | |
| Fam. Serranidae | | | | | | | | | | | |
| Cephalopholis argus | | | | R | | | | O | | | |
| Cephalopholis urodeta | | R | | | | | | R | | | |
| Epinephelus fasciatus | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | |
| Epinephelus hexagonatus | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | |
| Epinephelus merra | | O | | | | O | | | | | |
| Epinephelus microdon | | | | | | | | | | | |
| Epinephelus sp. | | | | | | | | | | | |
| Epinephelus tauvina | | | | | | | | | | | |
| Pseudanthias dispar | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Pseudanthias pascalus | | | | | | | | | | | |
| Plectropomus laevis | | | | | | | | | | | |
| Plectropomus areolatus | | | | | | | | | | | |
| Variola louti | | | | | | | | | | | |
| Fam. Pseudochromidae | | | | | | | | | | | |
| Pseudochromis sp. | | | | | | | | | | | |
| Fam. Cirrhitidae | | | | | | | | | | | |
| Paracirrhitus arcatus | | | | | | | | | | | |
| Paracirrhitus forsteri | | | | | | | | | | | |
| Fam. Kuhliidae | | | | | | | | | | | |
| Kuhlia mugil | | | | | | | | | | | |
| Fam. Grammistidae | | | | | | | | | | | |
| Belanoperca chaubanaudi | | | | | | | | | | | |
| Fam. Apogonidae | | | | | | | | | | | |
| Apogon amboinensis | | | | | | | | | | | |
| Apogon cyanosoma | | | | | | | | | | | |
| Apogon sp. cf A. sangiensis | | | | | O | | | | | | |
| Apogon sp. cf A. exostigma | | | | | | | | | | | |
| Apogon fraenatus | | | | | | | | | | | |
| Apogon leptacanthus | | C | | | | | | | | C | |
| Apogon novemfasciatus | | | | | | | | | | | |
| Archamia fucata | | | | | | | | | | | |
| Archamia zosterophora | | | | | | | | | | | |
| Cheilodipterus macrodon | | | | | | | | | | | |
| Cheilodipterus quinquelineata | | C | | | | | | | | | |
| Sphaeramia nematoptera | | | | | | | | | | | |
| Sphaeramia orbicularis | | | | | | | | | | | |
| Fam. Malacanthidae | | | | | | | | | | | |
| Malacanthus latovittatus | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Carangidae | | | | | | | | | | | |
| Carangoides orthagrammus | | | | | | | | | | | |
| Caranx melampygus | | | | | | | | | | | |
| Caranx sexfasciatus | | | | | | | | | | | |
| Gnathanodon speciosus | | | | | | | | | | | |
| Trachinotus baillonii | | | | | | | | | | | |
| Trachinotus blochii | | | | | | | | | | | |
| Fam. Lutjanidae | | | | | | | | | | | |
| Aphareus furca | | | O | | | | | | | | |
| Aprion virescens | | | | | | | | | | | |
| Lutjanus bohar | | | O | | | | | R | | | |
| Lutjanus ehrenbergi | | | | | | | | | | | |
| Lutjanus fulvus | | R | | R | | | | | | C | |
| Lutjanus gibbus | | | A | | O | | | | | O | O |
| Lutjanus kasmira | | | | A | | | | | | | |
| Lutjanus monostigmus | | | | | | | | | | R | |
| Lutjanus rivulatus | | | | | | | | | | | |
| Macolor niger | | | O | O | | | | | | | O |
| Fam. Caesionidae | | | | | | | | | | | |
| Caesio caerulaurea | | | R | | | | | | | | C |
| Caesio cuning | | | | | | | | | | | |
| Caesio lunaris | | | | | | | | | | | |
| Caesio teres | | | | | | | | | | | |
| Pterocaesio tile | | | R | O | | | | | | | |
| Caesio teres | | | | | | | | | | | |
| Pterocaesio marri | | | | | | | | | | | |
| Pterocaesio pisang | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Lethrinidae | | | | | | | | | | | |
| Gnathodentex aureolineatus | | O | | O | | O | | O | | C | C |
| Lethrinus amboinensis | | | | | | | | | | | |
| Lethrinus harak | | | | R | R | R | | | | | |
| Lethrinus elongatus | | | C | | | | | | | | |
| Lethrinus semicinctus | | | | | | O | | | | | |
| Lethrinus ornatus | | | | | | | | | | R | |
| Lethrinus sp. | | | C | | | R | | | | | |
| Monotaxis grandoculis | | O | | O | | | | | | C | O |
| Fam. Nemipteridae | | | | | | | | | | | |
| Pentapodus macrurus | | | | | | | | | | | |
| Scolopsis bilineatus | | | | R | | | | | | | |
| Scolopsis lineatus | | | | | | O | | | | | |
| Scolopsis ciliatus | | | | | | | | | | | |
| Scolopsis cf. xenochrous | | R | | | | | | | | | |
| Scolopsis trilineatus | | | | | | O | | | | R | |
| Fam. Gerreidae | | | | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | | | | |
| Fam. Mullidae | | | | | | | | | | | |
| Mulloides flavolineatus | | O | | | | O | | | | C | |
| Mulloides vanicolensis | | | | | | | | | | | |
| Parupeneus barberinus | | | | O | | O | | | | R | |
| Parupeneus bifasciatus | | | R | | | | | | | | |
| Parupeneus ciliatus | | | | | | | | | | | |
| Parupeneus cyclostomus | | | | | | | | | | | |
| Parupeneus indicus | | | | | | | | | | | |
| Parupeneus multifasciatus | | O | R | R | O | O | | R | | O | O |
| Parupeneus pleurostigma | | | | | | | | | | | |
| Parupeneus sp. | | | | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | | | | |
| Upeneus vittatus | | | | | | | | | | | |

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Kyphosidae | | | | | | | | | | | |
| Kyphosus cinerascens | | | | | | | | | | | C |
| Kyphosus lembus | | | | O | | | | | | | O |
| Kyphosus sp. | | | | | | | | | | | |
| Kyphosus vaigiensis | | | | | | | | | | | |
| Fam. Ephippidae | | | | | | | | | | | |
| Platax orbicularis | | | | | | | | R | | | |
| Fam. Toxotidae | | | | | | | | | | | |
| Toxotes jactator | | | | | | | | | | | |
| Fam. Scatophagidae | | | | | | | | | | | |
| Scatophagus argus | | | | | | | | | | | |
| Fam. Chaetodontidae | | | | | | | | | | | |
| Chaetodon auriga | | O | | R | R | O | | | | O | |
| Chaetodon bennetti | | | | R | | | | | | | R |
| Chaetodon citrinellus | | | | O | | O | | | | O | |
| Chaetodon ephippium | | O | | | R | O | | | | R | |
| Chaetodon kleinii | | | | | | | | | | R | O |
| Chaetodon lineolatus | | | O | R | R | | | | | | |
| Chaetodon lunula | | O | O | | | O | | R | | | |
| Chaetodon melannotus | | | | | R | | | | | R | |
| Chaetodon mertensii | | | | | | | | | | R | |
| Chaetodon meyeri | | | | | | | | | | | |
| Chaetodon ornatissimus | | O | | | | | | | | | R |
| Chaetodon plebius | | | | | | | | | | | |
| Chaetodon punctatofasciatus | | | O | | | | | O | | | R |
| Chaetodon rafflesii | | | | | | | | R | | R | |
| Chaetodon reticulatus | | R | O | O | | | | O | | | |
| Chaetodon semeion | | O | | | | | | | | | |
| Chaetodon trifascialis | | O | O | | R | | | R | | R | O |
| Chaetodon trifasciatus | | R | O | O | R | O | | O | | O | C |

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Chaetodon ulietensis | | R | | | | | | O | | O | O |
| Chaetodon unimaculatus | | | | O | | | | | | | |
| Chaetodon vagabundus | | O | O | R | R | O | | | | R | O |
| Forcipiger flavissimus | | | R | R | | | | R | | | |
| Forcipiger longirostris | | | O | | | | | | | | R |
| Hemitaurichthys polylepis | | | A | | | | | A | | | A |
| Heniochus acuminatus | | | | | | | | | | | |
| Heniochus chrysostomus | | R | R | | R | R | | | | | O |
| Heniochus monoceros | | R | R | | | | | | | R | O |
| Heniochus varius | | | O | | | | | O | | | O |
| Fam Pempheridídae | | | | | | | | | | | |
| Pempheris oualensis | | | | O | | | | | | | |
| Fam. Pomacanthidae | | | | | | | | | | | |
| Centropyge bicolor | | | | | | | | | | | |
| Centropyge bispinosus | | | | | | | | R | | | R |
| Centropyge flavissimus | | | | | | | | | | | |
| Centropyge heraldi | | | | | | | | | | | |
| Centropyge loriculus | | | | | | | | | | | |
| Centropyge nox | | | | | | | | | | | |
| Centropyge tibicen | | | | | | | | | | R | |
| Centropyge vrolicki | | R | | | | | | | | R | |
| Pomacanthus imperator | | | | O | | | | | | | |
| Pomacanthus sextriatus | | | | R | R | | | | | | |
| Pomacanthus xanthometopon | | | | | | | | | | | |
| Pygoplites diacanthus | | R | O | R | | | | R | | | |
| Fam. Pomacentridae | | | | | | | | | | | |
| Abudefduf septemfasciatus | | | | | | | | | | | |
| Abudefduf sexfasciatus | | O | | | O | | | | | C | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Abudefduf sordidus | | | | | | | | | | | |
| Abudefduf sp. | | | | | | | | | | | |
| Abudefduf saxatilis | | | | | | | | | | | |
| Amblyglyphidodon aureus | | | | | | | | | | | |
| Amblyglyphidodon curacao | | C | | O | O | O | | | | C | |
| Amblyglyphidodon leucogaster | | | | | | O | | R | | | |
| Amblyglyphidodon ternatensis | | | | | | | | | | | |
| Amphiprion chrysopterus | | | | | | | | | | | |
| Amphiprion clarkii | | | R | | | | | | | | |
| Amphiprion melanopus | | | | | | | | | | | |
| Amphiprion peridaeraion | | R | | | | | | | | | |
| Chromis agilis | | | | | | | | | | | |
| Chromis amboinensis | | | | | | | | | | | |
| Chromis atripectoralis | | | | | | | | | | C | O |
| Chromis atripes | | | | | | | | | | | |
| Chromis viridis | | C | A | | | | | | | A | C |
| Chromis lepidolepis | | | | A | | | | | | | |
| Chromis margaritifer | | | A | | | | | C | | O | |
| Chromis phillipinus | | | | | | | | | | | |
| Chromis sp. | | | | | | | | | | | |
| Chromis ternatensis | | | O | | | | | | | | |
| Chromis vaiuli | | | | | | | | | | | |
| Chromis vanderbilti | | | | | | | | | | | |
| Chromis xanthura | | | R | | | | | | | | |
| Chrysiptera cyanea | | C | | | | O | | | | | |
| Chrysiptera glauca | | | | | | | | | | | |
| Chrysiptera leucopoma | | | | | R | O | | | | | |
| Chrysiptera traceyi | | | | | | | | | | | |
| Dascyllus aruanus | | C | | | | C | | | | A | |
| Dascyllus melanurus | | | | | | R | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during he YORI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Dascyllus reticulatus | | C | C | | | | | O | | C | |
| Dascyllus trimaculatus | | | | O | | | | | | C | |
| Dischistodus chrysopoecilus | | | | | C | | | | | | |
| Dischistodus notopthalmus | | R | | | | O | | | | O | |
| Dischistodus perspicillatus | | O | | | O | O | | | | R | |
| Hemiglyphidodon plagiometapon | | | | | | | | | | | |
| Paraglyphidodon melas | | C | | | | | | | | | |
| Plectroglyphidodon dickii | | | | O | | | | O | | | C |
| Plectroglyphidodon johnstonianus | | | | | | | | | | | |
| Plectroglyphidodon lacrymatus | | | | | | | | O | | | O |
| Plectroglyphidodon leucozona | | | | | | | | | | | |
| Pomacentrus bankanensis | | | | | | | | | | R | |
| Pomacentrus coelestis | | | | | | | | | | O | |
| Pomacentrus moluccensis | | | | | | | | | | O | |
| Pomacentrus grammorhynchus | | | | | | | | | | | |
| Pomacentrus pavo | | O | | | O | | | | | O | |
| Pomancentrus phillipinus | | | | | | | | | | | |
| Pomacentrus sp. | | | | | | | | | | | |
| Pomacentrus vaiuli | | O | O | O | | | | | | | O |
| Stegastes albifasciatus | | | | | | | | | | | |
| Stegastes fasciolatus | | | | | | | | | | | |
| Stegastes lividus | | | | | O | | | | | | |
| Stegastes nigricans | | C | | | | O | | | | C | |
| Fam. Mugilidae | | | | | | | | | | | |
| Liza vaigiensis | | | | | | | | | | | |
| Valamugil engeli | | | | | | | | | | | |
| Valamugil sp. or seheli | | | | | | | | | | | |
| Fam. Sphyraenidae | | | | | | | | | | | |
| Sphyraena barracuda | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Labridae | | | | | | | | | | | |
| Anampses caeruleopunctatus | | | | | | | | | | | |
| Anampses melanurus | | | | | | | | | | | |
| Anampses meleagrides | | | | | | | | | | | R |
| Anampses twisti | | | | O | | | | | | | |
| Bodianus axillaris | | | | R | | | | | | | O |
| Bodianus bimaculatus or B.loxozona | | | | | | | | | | | |
| Cheilinus bimaculutus | | R | | | | | | | | | |
| Cheilinus celebicus | | R | | R | | | | R | | | |
| Cheilinus chlorourus | | | | | | | | | | | |
| Cheilinus digrammus | | O | | | | | | | | R | |
| Cheilinus fasciatus | | O | R | | | O | | O | | | R |
| Cheilinus trilobatus | | | | R | | R | | | | | |
| Cheilinus undulatus | | R | R | | | | | | | | |
| Cheilinus unifasciatus | | | R | O | | | | O | | | R |
| Cheilio inermis | | | | | | | | | | | |
| Choerodon anchorago | | O | | | O | | | | | R | |
| Cirrhilabrus n.sp.2 | | | | | | O | | | | O | |
| Coris aygula | | | | | | | | | | | |
| Coris gaimardi | | | R | | | | | | | R | |
| Diproctaconthus xanthurus | | | | | | | | | | | |
| Epibulus insidiator | | O | O | | | O | | O | | O | R |
| Gomphosus varius | | O | | R | | O | | | | | |
| Halichoeres biocellatus | | | | | | | | O | | | |
| Halichoeres chrysus | | | | | | | | | | | |
| Halichoeres chloropterus | | | | | | | | | | | |
| Halichoeres hortulanus | | | R | O | | | | O | | O | O |
| Halichoeres margaritaceus | | | | R | R | | | | | | |
| Halichoeres sp. | | | | | | | | | | R | |
| Halichoeres marginatus | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Halichoeres melanurus | | | | | | | | | | | |
| Halichoeres prosopeion | | | | | | O | | | | | |
| Halichoeres trimaculatus | | C | | | | O | | | | C | |
| Hemigymnus fasciatus | | O | R | | | | | R | | R | O |
| Hemigymnus melapterus | | O | R | | | O | | R | | R | R |
| Hologymnosus doliatus | | | | | | | | | | | |
| Labrichthys unilineatus | | O | | | | O | | | | O | |
| Labroides bicolor | | R | | | | | | | | R | |
| Labroides dimidiatus | | | R | O | R | R | | O | | O | O |
| Labroides pectoralis | | | | | | | | | | | |
| Labropsis xanthonota | | | | | | R | | | | | |
| Labropsis micronesica | | | | | | | | | | | |
| Macropharyngodon meleagris | | | | | | | | | | | |
| Macropharyngodon negrosensis | | | | | | | | | | | |
| Novaculichthys taeniourus | | | | | | | | | | | |
| Pseudocheilinus evanidus | | | | | | | | | | | |
| Pseudocheilinus hexataenia | | | | | | O | | | | R | R |
| Stethojulis bandanensis | | R | | | R | | | | | | |
| Stethojulis strigiventor | | | | | | | | | | | |
| Stethojulis trilineata | | | | | | | | | | R | |
| Thalassoma amblycephalum | | O | | O | O | | | | | C | O |
| Thalassoma hardwickii | | O | | O | | O | | | | C | |
| Thalassoma janseni | | | | | | | | | | | |
| Thalassoma lunare | | O | | O | | O | | | | R | |
| Thalassoma lutescens | | | | | | | | O | | | O |
| Thalassoma purpureum | | | | | | | | | | | |
| Thalassoma quinquevittatum | | | | | | | | O | | | |
| Thalassoma trilobatum | | | | | | | | | | | |
| Xyrichthys pavo | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Scaridae | | | | | | | | | | | |
| Bolbometopon muricatum | | | | R | | | | | | | |
| Calotomus carolinus sp.C.spinidens | | | | | | | | | | | |
| Cetoscarus bicolor | | | | R | | | | R | | | |
| Leptoscarus vaigiensis | | | | | O | | | | | | |
| Scarus altipinnis | | | | | | | | | | | O |
| Scarus atropectoralis | | | | | | | | | | | |
| Scarus dimidiatus | | | | | | | | | | R | O |
| Scarus forsteni | | | | | | | | | | | O |
| Scarus frenatus | | | | | | R | | | | | |
| Scarus frontalis | | | | | | | | | | | |
| Scarus ghobban | | | | | | | | | | O | |
| Scarus gibbus | | | O | | | | | O | | | O |
| Scarus globiceps | | | | | | | | | | | |
| Scarus javanicus | | R | | | | | | | | | |
| Hipposcarus longiceps | | | | R | | | | | | | O |
| Scarus niger | | R | O | R | | O | | O | | | C |
| Scarus oviceps | | O | C | | | O | | O | | O | O |
| Scarus prasiognathus | | | | | | | | | | | |
| Scarus psittacus | | | | | | | | R | | | O |
| Scarus quoyi | | | | | | | | | | | |
| Scarus rubroviolaceus | | | | | | | | | | | |
| Scarus schlegeli | | | O | O | | | | O | | | O |
| Scarus sordidus | | O | O | O | O | | | O | | C | O |
| Scarus sp. (juv.) | | C | | | C | O | | | | A | |
| Scarus spinus | | | | | | | | | | | |
| Scarus spp. (adult) | | R | | | | R | | | | R | |
| Scarus spp. (juv.) | | | | | | C | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Mugiloididae | | | | | | | | | | | |
| Parapercis millipunctata | | | | | | | | | | | |
| Parapercis clathrata | | | | | | | | | | | |
| Fam. Trichonotidae | | | | | | | | | | | |
| Trichonotus(?) | | | | | | | | | | | |
| Fam. Blenniidae | | | | | | | | | | | |
| Aspidontus taeniatus | | | | | | | | | | R | |
| Exalias brevis | | | | | | | | | | | |
| Istiblennius lineatus | | | | | | | | | | | |
| Meiacanthus atrodorsalis | | R | | R | | R | | | | O | |
| Meiacanthus grammistes | O | | | | | O | | | | O | |
| Plagiotremus rhynorhynchus | | | | | | | | | | | |
| Plagiotremus tapeinosoma | | | | | | | | | | | |
| Fam. Gobiidae | | | | | | | | | | | |
| Acentrogobius sp. | | O | | | O | | | | | | C |
| Amblygobius phalaena | | O | | | O | | | | | | |
| Asterropteryx semipunctatus | | | | | | | | | | | |
| Bathygobius fuscus | | | | | | | | | | | |
| Bathygobius youngei | | | | | | | | | | | |
| Eviota sp. | | | | | | | | | | | |
| Exyrias puntang | | | | | | | | | | | |
| Cryptocentrus sp. | | | | | | | | | | | |
| Goby sp. (with shrimp) | | | | | | | | | | | |
| Goby sp. | | | | | | | | | | | |
| Gobiodon sp. cf. G. okinawae | | | | | | | | | | | |
| Istigobius rigilius | | | | | | | | | | | |
| Oplopomus oplopomus | | | | | | | | | | | |
| Valenciennea strigatus | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Fam. Microdesmidae | | | | | | | | | | | |
| Nemateleotris magnifica | | | | | | | | | | | |
| Ptereleotris evides | | O | | | | | | | | | C |
| Ptereleotris sp. | | | | | | | | | | | |
| Ptereleotris tricolor | | | | | | | | | | | |
| Fam. Callionymidae | | | | | | | | | | | |
| Callionymus sp. | | | | | | | | | | | |
| Fam. Acanthuridae | | | | | | | | | | | |
| Acanthurus achilles | | | | | | | | | | | |
| Acanthurus chronixis | | | | | | | | | | | |
| Acanthurus dussumieri | | | | | | | | | | | |
| Acanthurus nigricans | | R | O | O | | R | | C | | C | |
| Acanthurus guttatus | | | | | | | | | | | |
| Acanthurus lineatus | | | O | | O | | | O | | | |
| Acanthurus blochii | | O | R | O | O | | | | | | |
| Acanthurus nigricauda | | | | | | | | | | | |
| Acanthurus nigrofuscus | | | | | O | O | | | | C | |
| Acanthurus nigroris | | | | | | | | | | | |
| Acanthurus olivaceus | | | | | | | | | | | |
| Acanthurus pyroferus | | | | C | | O | | R | | O | O |
| Acanthurus thompsoni | | | O | R | | | | | | | O |
| Acanthurus triostegus | | | | | O | O | | | | C | |
| Acanthurus xanthopterus | | | A | | R | | | O | | C | |
| Ctenochaetus binotatus | | C | | | | C | | R | | C | O |
| Ctenochaetus hawaiiensis | | | | | | | | | | | |
| Ctenochaetus striatus | | | C | C | | | | C | | | C |
| Ctenochaetus strigosus | | | | | | | | | | | |
| Naso annulatus | | | | | | | | | | | |
| Naso brevirostris | | | | | | | | R | | R | |
| Naso hexacanthus | | | | | | | | R | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Naso lituratus | | O | O | R | | | | | | C | O |
| Naso lopezi | | | O | | | | | C | | | O |
| Naso thynnoides | | | | | | | | | | | |
| Naso tuberosus | | | O | | | | | | | | O |
| Naso unicornis | | | | | | | | | | | |
| Naso vlamingii | | | | | | | | R | | | |
| Zebrasoma flavescens | | R | | | | | | | | | |
| Zebrasoma scopas | | O | O | | R | O | | O | | O | C |
| Zebrasoma veliferum | | O | R | O | O | O | | | | O | O |
| Fam. Zanclidae | | | | | | | | | | | |
| Zanclus cornutus | | O | | O | | O | | O | | O | O |
| Fam. Siganidae | | | | | | | | | | | |
| Siganus argenteus | | | | | | R | | | | O | |
| Siganus corallinus | | | | | | R | | | | | |
| Siganus canaliculatus | | | | | | | | | | | |
| Siganus doliatus | | O | | | | | | | | | |
| Siganus puellus | | O | | | | | | | | | |
| Siganus vulpinus | | O | | | | | | | | | O |
| Siganus lineatus | | | | | | | | | | C | |
| Siganus spinus | | | | | | | | | | | |
| Fam. Bothidae | | | | | | | | | | | |
| Bothus sp. | | | | | | | | | | | |
| Fam. Balistidae | | | | | | | | | | | |
| Balistapus undulatus | | | | R | | | | O | | | O |
| Balistoides conspicillum | | | | | | | | | | | |
| Balistoides viridescens | | | | | | | | | | R | |
| Melichthys niger | | | | O | | | | | | | |
| Melichthys vidua | | | R | | | | | O | | | |
| Pseudobalistes flavimarginatus | | | | | | | | | | | |
| Rhinecanthus aculeatus | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YORI survey.

| YAP ISLANDS SPECIES LIST | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| Rhinecanthus rectangulus | | | | | | | | | | | |
| Rhinecanthus verrucosa | | | | | | | | | | | |
| Sufflamen bursa | | | | | | | | | | | R |
| Sufflamen chrysoptera | | R | | | | | | | | | |
| Fam. Monacanthidae | | | | | | | | | | | |
| Aluterus scriptus | | | | | | | | | | | |
| Amanses scopas | | | | | | | | | | | |
| Cantherhines pardalis | | | | | | | | | | | |
| Cantherhines dumerilii | | | | | | | | | | | |
| Oxymonacanthus longirostris | | | | | | | | | | | |
| Paraluteres prionurus | | O | | | | | | | | R | |
| Pervagor sp. | | R | | | | | | | | | |
| Fam. Ostraciontidae | | | | | | | | | | | |
| Lactoria cornuta | | | | | | | | | | | |
| Ostracion cubicus | | | | | | | | | | | |
| Ostracion meleagris | | | | | | | | R | | | |
| Fam. Tetraodontidae | | | | | | | | | | | |
| Arothron hispidus | | | | | | | | | | | |
| Arothron manilensis | | | | | | | | | | | |
| Arothron meleagris | | | | | | | | | | | |
| Arothron stellatus | | | | | | | | | | | |
| Canthigaster amboinensis | | | | | | | | | | | |
| Canthigaster bennetti | | | | | | | | | | | |
| Canthigaster solandri | | | | | | | | | | | |
| Canthigaster valentini | | | | | | R | | | | R | |
| Fam. Diodontidae | | | | | | | | | | | |
| Diodon hystrix | | | | | | | | | | | |
| | | | | | | | | | | | |
| Class Reptilia | | | | | | | | | | | |
| Order Testudines | | | | | | | | | | | |
| Fam. Cheloniidae | | | | | | | | | | | |
| Chelonia mydas | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| FISH | | | | | | | | | | | | | | | |
| PHYLUM CHORDATA | | | | | | | | | | | | | | | |
| Fam. Carcharhinidae | | | | | | | | | | | | | | | |
| Carcharhinus albimarginatus | | | | | | | | | | | | | | | |
| Carcharhinus amblyrhynchos | | | | | | | | | | | | | | | |
| Carcharhinus melanopterus | | | | | | | | | | | | | | | |
| Fam. Hemigaleidae | | | | | | | | | | | | | | | |
| Triaenodon obesus | | | | | | | | | | | | | | | |
| Fam. Orectolobidae | | | | | | | | | | | | | | | |
| Nebrius concolor | | | | | | | | | | | | | | | |
| Fam. Dasyatididae | | | | | | | | | | | | | | | |
| Dasyatis kuhlii | | | | | | | | | | | | | | | |
| Stingray | | | | | | | | | | | | | | | |
| Fam. Urolophidae | | | | | | | | | | | | | | | |
| Urolophus sp. | | | | | | | | | | | | | | | |
| Fam. Mobulidae | | | | | | | | | | | | | | | |
| Manta alfredi | | | | | | | | | | | | | | | |
| Manta sp. | | | | | | | | | | | | | | | |
| Fam. Myliobatidae | | | | | | | | | | | | | | | |
| Aetobatus narinari | | | | | | | | | | | | | | | |
| Fam. Muraenidae | | | | | | | | | | | | | | | |
| Echidna nebulosa | | | | | | | | | | | | | | | |
| Gymnothorax javanicus | | | | | | | | | | | | | | | |
| Gymnothorax flavimarginatus | | | | | | | | | | | | | | | |
| Gymnothorax meleagris | | | | | | | | | | | | | | | |
| Siderea picta | | | | | | | | | | | | | | | |
| Fam. Clupeidae | | | | | | | | | | | | | | | |
| Spratelloides delicatulus | | | | | | | | | | A | A | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Synodontidae | | | | | | | | | | | | | | | |
| Saurida gracilis | | | | | | | | | | | | | | | |
| Synodus sp. | | R | | | | R | | R | | | | | | | |
| Synodus variegatus | | | | | | | | | | | | | | | |
| Fam. Chanidae | | | | | | | | | | | | | | | |
| Chanos chanos | | | | | | | | | | | | | | | |
| Fam. Belonidae | | | | | | | | | | | | | | | |
| Platybelone argalus platyura | | | | | | | | | | | | | | | |
| Strongylura incisa | | | | | | | | | | | | | | | |
| Fam. Hemiramphidae | | | | | | | | | | | | | | | |
| Hemiramphus sp. | | | | | | | | | | | | | C | | |
| Fam. Haemulidae | | | | | | | | | | | | | | | |
| Diagramma pictum | | | | | | | | | | | | | | | |
| Plectorhinchus chaetodontoides | | | | | | | | | | | | | | | |
| Plectorhinchus gaterinoides | | | | | | | | | | | | | | | |
| Plectorhinchus goldmanni | | | | | | | | | | | | | | | |
| Plectorhinchus orientalis | | | | | | | | | | | | | | | |
| Plectorhinchus gibbosus | | | | | | | | | | | | | | | |
| Plectorhinchus pictus | | | | R | | | | | | | | | | | |
| Fam. Plotosidae | | | | | | | | | | | | | | | |
| Plotosus lineatus | | | | | | | | | | | | | | | |
| Fam. Holocentridae | | | | | | | | | | | | | | | |
| Myripristis adustus | | | | O | O | | | | | | | | | | |
| Myripristis berndti | | | | O | O | | | | | | | | | | |
| Myripristis kuntee | | | | | | | | | | | | | | | |
| Myripristis murdjan | | | | | | | | | | | | | | | |
| Myripristis violacea | | | | | O | | | | | | | | | | |
| Neoniphon opercularis | O | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Neoniphon sammara | | | | | | | | | R | | | | | | |
| Sargocentron caudimaculatum | O | | | | | | | | | | | | | | |
| Sargocentron diadema | | | | | | | | | | | | | | | |
| Sargocentron microstoma | | | | | | | | | | | | | | | |
| Sargocentron punctatissimum | | | | | | | | | | | | | | | |
| Sargocentron spiniferum | O | | | | | R | | | | | | | | O | |
| Fam. Aulostomidae | | | | | | | | | | | | | | | |
| Aulostomus chinensis | | | | | | | | | | | | | | | |
| Fam. Fistulariidae | | | | | | | | | | | | | | | |
| Fistularia commersonii | | | | | | | | | | | | | | | |
| Fam. Sygnathidae | | | | | | | | | | | | | | | |
| Corythoichthys intestinalis | C | | | | | | | O | | | | | | | |
| Fam. Scorpaenidae | | | | | | | | | | | | | | | |
| Pterois antennata | | | | | | | | | | | | | | | |
| Pterois volitans | | | | | | | | | | | | | | | R |
| Fam. Caracanthidae | | | | | | | | | | | | | | | |
| Caracanthus maculatus | | | | | | | | | | | | | | | |
| Fam. Serranidae | | | | | | | | | | | | | | | |
| Cephalopholis argus | | | | | O | | | | | | | | | | |
| Cephalopholis urodeta | | | | | R | R | | | | | | | | | |
| Epinephelus fasciatus | | | | | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | | | | | |
| Epinephelus hexagonatus | R | | | | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | | | | | |
| Epinephelus merra | | | | | | | | | | | | | | | |
| Epinephelus microdon | | | | | | | | | | | | | | | |
| Epinephelus sp. | | | | | | | | | | | | | | | |
| Epinephelus tauvina | | | | | | | | | | | | | | | |
| Pseudanthias dispar | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SECTION 4 | | | | | | | | | | | | | | |
| Pseudanthias pascalus | | | | O | A | | | | | | | | | | |
| Plectropomus laevis | | | | | | | | | | | | | | | |
| Plectropomus areolatus | | | | | | | | | | | | | | | |
| Variola louti | | | | | | | | | | | | | | | |
| Fam. Pseudochromidae | | | | | | | | | | | | | | | |
| Pseudochromis sp. | | | | | | | | | | | | | | R | R |
| Fam. Cirrhitidae | | | | | | | | | | | | | | | |
| Paracirrhitus arcatus | | | | | | | | | | | | | | | |
| Paracirrhitus forsteri | | | | | | | | | | | | | | | |
| Fam. Kuhliidae | | | | | | | | | | | | | | | |
| Kuhlia mugil | | | | | | | | | | | | | | | |
| Fam. Grammistidae | | | | | | | | | | | | | | | |
| Belanoperca chaubanaudi | | | | | | | | | | | | | | | |
| Fam. Apogonidae | | | | | | | | | | | | | | | |
| Apogon amboinensis | | | | | | | | | | | | | | | |
| Apogon cyanosoma | | | | | | | | | | | | | | | |
| Apogon sp. cf A. sangiensis | | | | | | | | O | C | C | C | C | O | | R |
| Apogon sp. cf A. exostigma | | | | | | | | | | | | | | | |
| Apogon fraenatus | | | | | | O | | | | | | C | | | |
| Apogon leptacanthus | | | | | | O | O | | C | | | | | | |
| Apogon novemfasciatus | O | | | | | | | | | | | | | | |
| Archamia fucata | | | | | | O | O | O | | | | | | | |
| Archamia zosterophora | | | | | | O | O | O | O | | | | | | |
| Cheilodipterus macrodon | | | | | | | | O | | | | | | | |
| Cheilodipterus quinquelineata | O | | | | | O | | | O | | | C | | O | O |
| Sphaeramia nematoptera | | | | | | | C | C | C | | | | | O | C |
| Sphaeramia orbicularis | | | | | | | | | | O | | | | | |
| Fam. Malacanthidae | | | | | | | | | | | | | | | |
| Malacanthus latovittatus | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Lethrinidae | | | | | | | | | | | | | | | |
| Gnathodentex aureolineatus | C | C | | A | | O | | R | | | | | | | |
| Lethrinus amboinensis | | | | | | | | | | | | | | | |
| Lethrinus harak | | O | | | | | R | | | | | | | | |
| Lethrinus elongatus | | | | | | | | | | | | | | | |
| Lethrinus semicinctus | | | | | | R | | | | | | | | | |
| Lethrinus ornatus | | | | | | | | | | | | | | | |
| Lethrinus sp. | | | | | | | | | | | | R | | | |
| Monotaxis grandoculis | | O | | R | A | O | | | R | | | | | | |
| Fam. Nemipteridae | | | | | | | | | | | | | | | |
| Pentapodus macrurus | | | | | | R | | | | | | | | | |
| Scolopsis bilineatus | | | | | | | | | | | | | | | |
| Scolopsis lineatus | | | | | | | | | | | | | | | |
| Scolopsis ciliatus | | | | | | | R | | R | | O | C | | | R |
| Scolopsis cf. xenochrous | | O | | | | | | | | | | | | | |
| Scolopsis trilineatus | | | | | | | | | R | | | | | | |
| Fam. Gerreidae | | | | | | | | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | | | | O | R | | | |
| Fam. Mullidae | | | | | | | | | | | | | | | |
| Mulloides flavolineatus | | O | | | | O | | | O | | | | | | |
| Mulloides vanicolensis | O | R | | | | | | | O | | | | | | |
| Parupeneus barberinus | O | O | | | | | | R | | | | | | R | |
| Parupeneus bifasciatus | | | | | | | | | | | | | | | |
| Parupeneus ciliatus | | R | | | | | | | | | | | | | |
| Parupeneus cyclostomus | O | | | | | | | | R | | | | | | |
| Parupeneus indicus | | R | | | | | | | | | | | | | |
| Parupeneus multifasciatus | O | O | | O | R | O | | O | | | | | | O | |
| Parupeneus pleurostigma | | | | | | | | | | | | | | | |
| Parupeneus sp. | | | | | | | | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | | | | | | | | |
| Upeneus vittatus | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Carangidae | | | | | | | | | | | | | | | |
| Carangoides orthagrammus | | | | | | | | | | | | | | | |
| Caranx melampygus | | | | | | O | | | | | | | | | |
| Caranx sexfasciatus | | | | | | | | | | | | | | | |
| Gnathanodon speciosus | | | | | | R | | | R | | | | | | |
| Trachinotus baillonii | | | | | | | | | | | | | | | |
| Trachinotus blochii | | | | | | | | | | | | | | | |
| Fam. Lutjanidae | | | | | | | | | | | | | | | |
| Aphareus furca | | | | O | | | | | | | | | | | |
| Aprion virescens | | | | R | R | | | | | | | | | | |
| Lutjanus bohar | | | | | | | | | | | | | | | |
| Lutjanus ehrenbergi | | | | | | | | | | | | R | | | |
| Lutjanus fulvus | | | | | | | | | R | R | | C | | | |
| Lutjanus gibbus | | | | O | | | | | R | | | | | | O |
| Lutjanus kasmira | | | | | | | | | | | | | | | |
| Lutjanus monostigmus | | | | | | | | | | | | | | | |
| Lutjanus rivulatus | | | | | | | | | | | | | | | |
| Macolor niger | | | | | | | | | | | | | | | |
| Fam. Caesionidae | | | | | | | | | | | | | | | |
| Caesio caerulaurea | | | | | | | | | | | | | | | |
| Caesio cuning | | | | | | | | | | | | | | | |
| Caesio lunaris | | | | | | | | | | | | | | | |
| Caesio teres | | | | | | | | | | | | | | | |
| Pterocaesio tile | | | | O | | O | | | | | | | | | |
| Caesio teres | | | | | C | | | | | | | | | | |
| Pterocaesio marri | | | | | | | | | | | | | | | |
| Pterocaesio pisang | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Lethrinidae | | | | | | | | | | | | | | | |
| Gnathodentex aureolineatus | C | C | | A | | O | | R | | | | | | | |
| Lethrinus amboinensis | | | | | | | | | | | | | | | |
| Lethrinus harak | | O | | | | | R | | | | | | | | |
| Lethrinus elongatus | | | | | | | | | | | | | | | |
| Lethrinus semicinctus | | | | | | R | | | | | | | | | |
| Lethrinus ornatus | | | | | | | | | | | | | | | |
| Lethrinus sp. | | | | | | | | | | | | R | | | |
| Monotaxis grandoculis | | O | | R | A | O | | | R | | | | | | |
| Fam. Nemipteridae | | | | | | | | | | | | | | | |
| Pentapodus macrurus | | | | | | R | | | | | | | | | |
| Scolopsis bilineatus | | | | | | | | | | | | | | | |
| Scolopsis lineatus | | | | | | | | | | | | | | | |
| Scolopsis ciliatus | | | | | | | R | | R | | O | C | | | R |
| Scolopsis cf. xenochrous | | O | | | | | | | | | | | | | |
| Scolopsis trilineatus | | | | | | | | | R | | | | | | |
| Fam. Gerreidae | | | | | | | | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | | | | O | R | | | |
| Fam. Mullidae | | | | | | | | | | | | | | | |
| Mulloides flavolineatus | | O | | | | O | | | O | | | | | | |
| Mulloides vanicolensis | O | R | | | | | | | O | | | | | | |
| Parupeneus barberinus | O | O | | | | | | R | | | | | | R | |
| Parupeneus bifasciatus | | | | | | | | | | | | | | | |
| Parupeneus ciliatus | | R | | | | | | | | | | | | | |
| Parupeneus cyclostomus | O | | | | | | | | R | | | | | | |
| Parupeneus indicus | | R | | | | | | | | | | | | | |
| Parupeneus multifasciatus | O | O | | O | R | O | | O | | | | | | O | |
| Parupeneus pleurostigma | | | | | | | | | | | | | | | |
| Parupeneus sp. | | | | | | | | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | | | | | | | | |
| Upeneus vittatus | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Kyphosidae | | | | | | | | | | | | | | | |
| Kyphosus cinerascens | | | | | | | | | | | | | | | |
| Kyphosus lembus | | | | | | | | | | | | | | | |
| Kyphosus sp. | | | | | | | | | | | | | | | |
| Kyphosus vaigiensis | | | | | | | | | | | | | | | |
| Fam. Ephippidae | | | | | | | | | | | | | | | |
| Platax orbicularis | | | | | R | | | | | | | | | | |
| Fam. Toxotidae | | | | | | | | | | | | | | | |
| Toxotes jactator | | | | | | | | | | | O | O | | | |
| Fam. Scatophagidae | | | | | | | | | | | | | | | |
| Scatophagus argus | | | | | | | | | | C | C | C | | | |
| Fam. Chaetodontidae | | | | | | | | | | | | | | | |
| Chaetodon auriga | O | O | | R | | O | | R | O | | | | | O | R |
| Chaetodon bennetti | | | | R | O | | | | | | | | | | |
| Chaetodon citrinellus | O | O | | R | | | | | | | | | | | |
| Chaetodon ephippium | O | | | | | R | O | R | O | | | | | R | R |
| Chaetodon kleinii | O | O | | O | | O | O | O | | | | | | R | R |
| Chaetodon lineolatus | | O | | | | | | | | | | | | | |
| Chaetodon lunula | O | | | | | | | | | | | | | | |
| Chaetodon melannotus | | O | | | R | | | | | | | | | | |
| Chaetodon mertensii | | | | | | R | | | | | | | | | R |
| Chaetodon meyeri | | | | | | | | | | | | | | | |
| Chaetodon ornatissimus | O | O | | R | | | | | | | | | | | |
| Chaetodon plebius | | | | | | | | R | | | | | | | |
| Chaetodon punctatofasciatus | | | | O | O | | | | | | | | | | |
| Chaetodon rafflesii | | | | O | R | | | | | | | | | | |
| Chaetodon reticulatus | | R | | | O | | | | | | | | | | |
| Chaetodon semeion | | | | | | | | R | | | | | | | |
| Chaetodon trifascialis | O | O | | | O | | | | | | | | | | |
| Chaetodon trifasciatus | O | O | | O | O | O | O | O | O | | | | | O | |
| Chaetodon ulietensis | | | | O | O | O | R | O | O | | | | | | |

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chaetodon unimaculatus | R | O | | O | | | | | | | | | | | |
| Chaetodon vagabundus | R | O | | O | | R | | | O | | | | | | R |
| Forcipiger flavissimus | | R | | O | O | R | | | | | | | | | |
| Forcipiger longirostris | | R | | O | | | | | | | | | | | |
| Hemitaurichthys polylepis | | | | A | A | | | | | | | | | | |
| Heniochus acuminatus | | | | | | | | | | | | | | | R |
| Heniochus chrysostomus | O | R | | O | | R | | | | | | | | | |
| Heniochus monoceros | | | | | | | | | | | | | | | |
| Heniochus varius | | | | O | | | | R | | | | | | | |
| Fam Pempheridídae | | | | | | | | | | | | | | | |
| Pempheris oualensis | | | | O | | | | | | | | | | | |
| Fam. Pomacanthidae | | | | | | | | | | | | | | | |
| Centropyge bicolor | | | | | | O | O | | | | | | | | |
| Centropyge bispinosus | | R | | R | | | | | | | | | | | |
| Centropyge flavissimus | | | | | | | | | | | | | | | |
| Centropyge heraldi | | | | | | | | | | | | | | | |
| Centropyge loriculus | | | | R | | | | | | | | | | | |
| Centropyge nox | | | | | | | | | | | | | | | |
| Centropyge tibicen | | | | | | O | | | | | | | | | |
| Centropyge vrolicki | | | | R | O | | | | | | | | | O | |
| Pomacanthus imperator | | | | | | R | | | | | | | | | |
| Pomacanthus sextriatus | | | | | | | | | | | | | | | |
| Pomacanthus xanthometopon | | | | | | | | | | | | | | | |
| Pygoplites diacanthus | | | | R | O | O | | | | | | | | | |
| Fam. Pomacentridae | | | | | | | | | | | | | | | |
| Abudefduf septemfasciatus | | | | | | | | | | | | | | | |
| Abudefduf sexfasciatus | O | C | | | | | | | | | | | | C | |

Appendix B
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Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Abudefduf sordidus | | | | | | | | | | | | | | | |
| Abudefduf sp. | | | | | | | | | | | | | | | |
| Abudefduf saxatilis | | | | A | | | | | | | | | | | |
| Amblyglyphidodon aureus | | | | R | | | | | | | | | | R | |
| Amblyglyphidodon curacao | C | C | | | A | C | C | C | O | | | | | C | C |
| Amblyglyphidodon leucogaster | | | | | | | | | | | | | | | |
| Amblyglyphidodon ternatensis | | | | | | | R | | | | | | | | |
| Amphiprion chrysopterus | | | | | | | | | | | | | | | |
| Amphiprion clarkii | | | | R | | | | | | | | | | | |
| Amphiprion melanopus | O | | | | | O | | | | | | | | | |
| Amphiprion peridaeraion | | | | | | | | | | | | | | | |
| Chromis agilis | | | | | | | | | | | | | | | |
| Chromis amboinensis | | | | | | | | | | | | | | | |
| Chromis atripectoralis | | | | | | | | | | | | | | | |
| Chromis atripes | | | | | A | | | | | | | | | | |
| Chromis viridis | A | C | | | | C | | | O | | | | | | |
| Chromis lepidolepis | | | | | | O | | | | | | | | | |
| Chromis margaritifer | C | O | | C | C | | | | | | | | | | |
| Chromis phillipinus | | | | | | | | | | | | | | | |
| Chromis sp. | | | | | | | | | | | | | | | |
| Chromis ternatensis | | | | O | | | | | | | | | | | |
| Chromis vaiuli | | | | | | | | | | | | | | | |
| Chromis vanderbilti | | | | | | | | | | | | | | | |
| Chromis xanthura | | | | | O | | | | | | | | | | |
| Chrysiptera cyanea | C | O | | | | C | | | | | | | | O | |
| Chrysiptera glauca | | | | | | | | | | | | | | | |
| Chrysiptera leucopoma | C | C | | | | | | | | | | | | C | |
| Chrysiptera traceyi | | | | | | | | | | | | | | | |
| Dascyllus aruanus | C | C | | | | O | C | | | | | | | C | |
| Dascyllus melanurus | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Dascyllus reticulatus | C | C | | C | C | | | | | | | | | | |
| Dascyllus trimaculatus | O | C | | O | | O | | | | | | | | | |
| Dischistodus chrysopoecilus | | | | | | R | | | | | | | | O | |
| Dischistodus notopthalmus | | C | | | | | | | | | | | | | |
| Dischistodus perspicillatus | | O | | | | | O | | O | | | O | | O | O |
| Hemiglyphidodon plagiometapon | | | | | | | | C | | | | | | | |
| Paraglyphidodon melas | | C | | | | | | | | | | | | | |
| Plectroglyphidodon dickii | O | O | | | | | | | | | | | | | |
| Plectroglyphidodon johnstonianus | | | | | | | | | | | | | | | |
| Plectroglyphidodon lacrymatus | O | C | | O | O | | | | | | | | | | |
| Plectroglyphidodon leucozona | O | | | | | | | | | | | | | | |
| Pomacentrus bankanensis | | | | | | | | | | | | | | | |
| Pomacentrus coelestis | | | | | | | | | | | | | | | |
| Pomacentrus moluccensis | | | | | | | | | | | | | | | |
| Pomacentrus grammorhynchus | | | | | | | | | | | | | | | |
| Pomacentrus pavo | O | O | | | | C | | | | | | | | O | R |
| Pomancentrus phillipinus | | | | | | | | | | | | | | | |
| Pomacentrus sp. | | | | | | | | | | | | | | | |
| Pomacentrus vaiuli | | | | O | | | | | | | | | | | |
| Stegastes albifasciatus | | | | | | | | | | | | | | | |
| Stegastes fasciolatus | | | | | | | | | | | | | | | |
| Stegastes lividus | | O | | | | | | | | | | | | C | |
| Stegastes nigricans | C | O | | | | | | | O | | | | | A | |
| Fam. Mugilidae | | | | | | | | | | | | | | | |
| Liza vaigiensis | | | | | | | | | | | | | | | |
| Valamugil engeli | | | | | | | | | | | | | | | |
| Valamugil sp. or seheli | | | | | | | | | | | | | | | |
| Fam. Sphyraenidae | | | | | | | | | | | | | | | |
| Sphyraena barracuda | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YORI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Labridae | | | | | | | | | | | | | | | |
| Anampses caeruleopunctatus | | R | | | | R | C | O | O | | | | | | |
| Anampses melanurus | | | | | | | | | | | | | | | |
| Anampses meleagrides | | | | | R | | | | | | | | | | |
| Anampses twisti | | | | R | O | | | | | | | | | | |
| Bodianus axillaris | | | | | | | | | | | | | | | |
| Bodianus bimaculatus or B.loxozona | | | | | | | | | | | | | | | |
| Cheilinus bimaculutus | | | | | | | | | | | | | | | |
| Cheilinus celebicus | | | | | | O | R | R | R | | | | | | |
| Cheilinus chlorourus | | O | | | | | | | | | | | | | |
| Cheilinus digrammus | | | | | | | | | | | | | | | |
| Cheilinus fasciatus | | O | | | | | | | | | | | | | |
| Cheilinus trilobatus | R | | | R | | | R | | | | | | | | |
| Cheilinus undulatus | | | | | | | | | | | | | | | |
| Cheilinus unifasciatus | | | | | | | | | | | | | | | |
| Cheilio inermis | R | | | | | | | | | | | | | | |
| Choerodon anchorago | O | R | | | | R | C | | O | | R | R | | O | |
| Cirrhilabrus n.sp.2 | | | | | | O | | | | | | | | | |
| Coris aygula | R | | | | | | | | | | | | | | |
| Coris gaimardi | O | | | | | | | | | | | | | | |
| Diproctaconthus xanthurus | | | | | | | | | | | | | | | |
| Epibulus insidiator | O | | | R | R | O | | | | | | | | | |
| Gomphosus varius | O | O | | R | R | R | | | | | | | | | |
| Halichoeres biocellatus | | | | R | | | | | | | | | | | |
| Halichoeres chrysus | | | | | | | | | | | | | | | |
| Halichoeres chloropterus | | | | | | | O | | O | | R | | | O | |
| Halichoeres hortulanus | | O | | O | O | | | | | | | | | | |
| Halichoeres margaritaceus | O | | | | | | | | | | | | | | |
| Halichoeres sp. | R | | | | | | | | | | | | | O | |
| Halichoeres marginatus | R | O | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Halichoeres melanurus | | | | | | R | | O | O | | | | | | R |
| Halichoeres prosopeion | | R | | | | | | | | | | | | | |
| Halichoeres trimaculatus | C | O | | | | | | | | | | | | | |
| Hemigymnus fasciatus | | | | O | R | | | | | | | | | | |
| Hemigymnus melapterus | O | O | | | O | | | | | | | | | R | |
| Hologymnosus doliatus | | | | R | | | | | | | | | | | |
| Labrichthys unilineatus | | | | | | | | | | | | | | | |
| Labroides bicolor | | | | | R | | | | | | | | | | |
| Labroides dimidiatus | R | O | | R | O | R | | | | | | | | | R |
| Labroides pectoralis | | | | | | | | | | | | | | | |
| Labropsis xanthonota | | | | | | | | | | | | | | | |
| Labropsis micronesica | | | | | | | | | | | | | | | |
| Macropharyngodon meleagris | | | | | | | | | | | | | | | |
| Macropharyngodon negrosensis | | | | | | | | | | | | | | | |
| Novaculichthys taeniourus | R | R | | | | | | | | | | | | | |
| Pseudocheilinus evanidus | | | | R | | | | | | | | | | | |
| Pseudocheilinus hexataenia | | | | | R | | | | | | | | | R | |
| Stethojulis bandanensis | O | O | | R | | | | | | | R | | | O | |
| Stethojulis strigiventor | | | | | | | | | | | | | | | |
| Stethojulis trilineata | | R | | | | | | | | | | | | | |
| Thalassoma amblycephalum | C | C | | | O | O | | | | | | | | | |
| Thalassoma hardwickii | O | C | | R | | O | | | | | | | | O | |
| Thalassoma janseni | | R | | | | | | | | | | | | | |
| Thalassoma lunare | | | | | | O | R | | | | | | | | |
| Thalassoma lutescens | | | | | O | | | | | | | | | | |
| Thalassoma purpureum | | | | | | | | | | | | | | | |
| Thalassoma quinquevittatum | | | | O | | | | | | | | | | | |
| Thalassoma trilobatum | | | | | | | | | | | | | | | |
| Xyrichthys pavo | | | | | | | | | | | | | | | |

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Scaridae | | | | | | | | | | | | | | | |
| Bolbometopon muricatum | | | | | | | | | | | | | | | |
| Calotomus carolinus sp.C.spinidens | | | | | | | | | | | | | | | |
| Cetoscarus bicolor | | | | O | O | | | | | | | | | | |
| Leptoscarus vaigiensis | | | | | | | | | | | | | | | R |
| Scarus altipinnis | | | | C | | | | | | | | | | | |
| Scarus atropectoralis | | | | | | | | | | | | | | | |
| Scarus dimidiatus | O | O | | O | O | O | | R | O | | | | | O | |
| Scarus forsteni | | R | | O | | R | | | | | | | | | |
| Scarus frenatus | | R | | R | | | | | | | | | | | |
| Scarus frontalis | | | | | | | | | | | | | | | |
| Scarus ghobban | | | | | | | R | O | O | | | | | | |
| Scarus gibbus | | | | | O | | | | | | | | | | |
| Scarus globiceps | | | | | | | | | | | | | | | |
| Scarus javanicus | | | | | | | | | | | | | | | |
| Hipposcarus longiceps | | | | R | | | | | | | | | | | |
| Scarus niger | | | | O | C | | | | | | | | | | |
| Scarus oviceps | O | | | O | C | | | | | | | | | | |
| Scarus prasiognathus | R | | | | | | | | | | | | | | |
| Scarus psittacus | | R | | | | | | | | | | | | | |
| Scarus quoyi | | | | | | | | | | | | | | | |
| Scarus rubroviolaceus | | | | O | O | | | | | | | | | | |
| Scarus schlegeli | | R | | R | R | | | | | | | | | | |
| Scarus sordidus | C | C | | | C | O | O | O | O | | | | | C | |
| Scarus sp. (juv.) | A | | | | | C | | | C | | | | | C | |
| Scarus spinus | | | | R | O | | | | | | | | | | |
| Scarus spp. (adult) | O | | | | | O | | R | O | | | | | | |
| Scarus spp. (juv.) | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Fam. Mugiloididae | | | | | | | | | | | | | | | |
| Parapercis millipunctata | | | | | | | | | | | | | | | |
| Parapercis clathrata | | | | | | | | | | | | | | | |
| Fam. Trichonotidae | | | | | | | | | | | | | | | |
| Trichonotus(?) | | | | | | | | | | | | | | | |
| Fam. Blenniidae | | | | | | | | | | | | | | | |
| Aspidontus taeniatus | | R | | | | | | | | | | | | | |
| Exalias brevis | | | | | | | | | | | | | | | |
| Istiblennius lineatus | | | | | | | | O | | | | | | | |
| Meiacanthus atrodorsalis | | | | | | | | | | | | | | O | |
| Meiacanthus grammistes | | | | | | R | R | R | O | O | | | | | |
| Plagiotremus rhynorhynchus | | | | | | | | | | | | | | | |
| Plagiotremus tapeinosoma | | | | | | R | | | | | | | | | |
| Fam. Gobiidae | | | | | | | | | | | | | | | |
| Acentrogobius sp. | | R | | | | | O | | | | | O | | | |
| Amblygobius phalaena | | R | | | | | O | | | O | O | O | O | C | O |
| Asterropteryx semipunctatus | | | | | | | | | | | | | | | O |
| Bathygobius fuscus | | | | | | | | | | | | | | | C |
| Bathygobius youngei | | | | | | | | | | | | | | | |
| Eviota sp. | | | | | | O | O | O | O | | | | | | O |
| Exyrias puntang | | | | | | | | O | | | | R | | | O |
| Cryptocentrus sp. | | | | | | | | | | | | | | | O |
| Goby sp. (with shrimp) | | | | | | | | | | C | C | C | | | O |
| Goby sp. | | | | | | | | | O | | | | O | | O |
| Gobiodon sp. cf. G. okinawae | | | | | | | | | | | | | | | |
| Istigobius rigilius | | | | | | | | | | | | | | | |
| Oplopomus oplopomus | | | | | | | | | | | | | | | |
| Valenciennea strigatus | | | | | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SECTION 4 | | | | | | | | | | | | | | |
| Fam. Microdesmidae | | | | | | | | | | | | | | | |
| Nemateleotris magnifica | | | | | | | | | | | | | | | |
| Ptereleotris evides | | | | C | C | | | | | | | | | | |
| Ptereleotris sp. | | | | | | | | | | | | | | | O |
| Ptereleotris tricolor | | | | | | | | | | | | | | | |
| Fam. Callionymidae | | | | | | | | | | | | | | | |
| Callionymus sp. | | | | | | | | | | R | | | | | |
| Fam. Acanthuridae | | | | | | | | | | | | | | | |
| Acanthurus achilles | | | | | | | | | | | | | | | |
| Acanthurus chronixis | | | | | | | | | | | | | | | |
| Acanthurus dussumieri | | | | | | | | | | | | | | | |
| Acanthurus nigricans | O | | | C | O | | | | | | | | | | |
| Acanthurus guttatus | | | | | | | | | | | | | | | |
| Acanthurus lineatus | O | O | | | | | | | | | | | | | |
| Acanthurus blochii | | C | | | | O | | O | O | R | | O | | O | |
| Acanthurus nigricauda | | | | | | | | | | | | | | | |
| Acanthurus nigrofuscus | | | | | | O | O | | | | | | | | |
| Acanthurus nigroris | | | | | | | | | | | | | | | |
| Acanthurus olivaceus | | | | | | | | | | | | | | | |
| Acanthurus pyroferus | | O | | O | | O | | | | | | | | | |
| Acanthurus thompsoni | | | | C | A | | | | | | | | | | |
| Acanthurus triostegus | O | C | | A | | | | | | | | | | | |
| Acanthurus xanthopterus | R | O | | O | | | | | O | | | | | | |
| Ctenochaetus binotatus | | C | | | R | O | O | O | O | | | | | C | |
| Ctenochaetus hawaiiensis | | | | | | | | | | | | | | | |
| Ctenochaetus striatus | A | C | | A | | | O | C | | | | | | C | |
| Ctenochaetus strigosus | | | | | | | | | | | | | | | |
| Naso annulatus | | | | | | | | | | | | | | | |
| Naso brevirostris | | | | O | A | | | | R | | | | | R | |
| Naso hexacanthus | | | | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Naso lituratus | O | | | R | O | | R | | | | | | | | |
| Naso lopezi | | | | O | | | | | | | | | | | |
| Naso thynnoides | | | | | | | | | | | | | | | |
| Naso tuberosus | | | | | | | | | | | | | | | |
| Naso unicornis | | | | | | | | | | | | | | | |
| Naso vlamingii | | | | R | R | | | | | | | | | | |
| Zebrasoma flavescens | | | | | R | | | | | | | | | | |
| Zebrasoma scopas | | O | | | C | O | O | C | | | | | | O | |
| Zebrasoma veliferum | | | | O | | | O | O | O | | | | | | |
| Fam. Zanclidae | | | | | | | | | | | | | | | |
| Zanclus cornutus | O | O | | O | | O | O | O | R | | | | | | R |
| Fam. Siganidae | | | | | | | | | | | | | | | |
| Siganus argenteus | | O | | | | | | | | | | | | | |
| Siganus corallinus | | | | O | | | | | | | | | | | |
| Siganus canaliculatus | | | | | | | O | | O | | | O | | | |
| Siganus doliatus | | | | | | | O | | O | | | | | | |
| Siganus puellus | | | | | | | R | O | O | | | | | | |
| Siganus vulpinus | | | | O | O | | R | R | | | | | | | |
| Siganus lineatus | | | | | | | | | | R | | | | | |
| Siganus spinus | O | | | | | | | | | | | O | | | |
| Fam. Bothidae | | | | | | | | | | | | | | | |
| Bothus sp. | | | | | | | | | | | | | | | |
| Fam. Balistidae | | | | | | | | | | | | | | | |
| Balistapus undulatus | O | | | | O | | | | | | | | | R | |
| Balistoides conspicillum | | | | | | | | | | | | | | | |
| Balistoides viridescens | | | | | | | | | | | | | | | |
| Melichthys niger | | | | | | | | | | | | | | | |
| Melichthys vidua | | | | R | | | | | | | | | | | |
| Pseudobalistes flavimarginatus | | | | | | | | | | | | | | | R |
| Rhinecanthus aculeatus | | O | | | | | | | | | | | | | |

## Appendix B
## (cont'd)
## Conspicuous fish species observerd during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
| Rhinecanthus rectangulus | | | | | | | | | | | | | | | |
| Rhinecanthus verrucosa | | | | | | | | | | | | | | | |
| Sufflamen bursa | | | | | | | | | | | | | | | |
| Sufflamen chrysoptera | R | O | | | | | | | | | R | | | | |
| Fam. Monacanthidae | | | | | | | | | | | | | | | |
| Aluterus scriptus | | | | | | | | | | | | | | | |
| Amanses scopas | | | | | | | | | | | | | | | |
| Cantherhines pardalis | | | | | | | | | | | | | | | |
| Cantherhines dumerilii | | | | | | | | | | | | | | | |
| Oxymonacanthus longirostris | O | | | | | | | | | | | | | | |
| Paraluteres prionurus | R | | | | | | | | | | | | | | |
| Pervagor sp. | | | | | | | | | | | | | | | |
| Fam. Ostraciontidae | | | | | | | | | | | | | | | |
| Lactoria cornuta | | | | | | | | | | | | | | | |
| Ostracion cubicus | | | | | | | | | | | | | | | |
| Ostracion meleagris | | | | | | | | | | | | | | | |
| Fam. Tetraodontidae | | | | | | | | | | | | | | | |
| Arothron hispidus | | | | | O | R | | | | | | | | R | |
| Arothron manilensis | | | | | | | | | | | | | | | |
| Arothron meleagris | | | | | | | | | | | | | | | |
| Arothron stellatus | | | | | O | | | | | | | | | | |
| Canthigaster amboinensis | | | | | | | | | | | | | | | |
| Canthigaster bennetti | | | | | | | | | | | | | | | |
| Canthigaster solandri | | | | | | | | | | | | | | | |
| Canthigaster valentini | | R | | | | | | | | | | | | | R |
| Fam. Diodontidae | | | | | | | | | | | | | | | |
| Diodon hystrix | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Class Reptilia | | | | | | | | | | | | | | | |
| Order Testudines | | | | | | | | | | | | | | | |
| Fam. Cheloniidae | | | | | | | | | | | | | | | |
| Chelonia mydas | | | | | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| FISH | | | | | | | | | | | |
| PHYLUM CHORDATA | | | | | | | | | | | |
| Fam. Carcharhinidae | | | | | | | | | | | |
| Carcharhinus albimarginatus | | | | | | | | | | | |
| Carcharhinus amblyrhynchos | O | | | | | | | | | | |
| Carcharhinus melanopterus | R | | | | | | | | | | |
| Fam. Hemigaleidae | | | | | | | | | | | |
| Triaenodon obesus | R | | | | | | | | | | |
| Fam. Orectolobidae | | | | | | | | | | | |
| Nebrius concolor | | | | | | | | | | | |
| Fam. Dasyatididae | | | | | | | | | | | |
| Dasyatis kuhlii | | | | | | | | | | | |
| Stingray | | | | | | | | | | | |
| Fam. Urolophidae | | | | | | | | | | | |
| Urolophus sp. | | | | | | | | | | | |
| Fam. Mobulidae | | | | | | | | | | | |
| Manta alfredi | | | | | | | | | | | |
| Manta sp. | | | | | | | | | | | |
| Fam. Myliobatidae | | | | | | | | | | | |
| Aetobatus narinari | | | | | | | | | | | |
| Fam. Muraenidae | | | | | | | | | | | |
| Echidna nebulosa | | | | | | | | | | | |
| Gymnothorax javanicus | | | R | | | | | | | | |
| Gymnothorax flavimarginatus | | | | | | | | | | | |
| Gymnothorax meleagris | | | | | | | | | | | |
| Siderea picta | | | | | | | R | | | | |
| Fam. Clupeidae | | | | | | | | | | | |
| Spratelloides delicatulus | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a | |
| Fam. Synodontidae | | | | | | | | | | | | |
| Saurida gracilis | | | R | | | | | | | | | |
| Synodus sp. | | | | R | | | | | | | | |
| Synodus variegatus | | R | | | | | | | | | | |
| Fam. Chanidae | | | | | | | | | | | | |
| Chanos chanos | | | | | | | | | | | | |
| Fam. Belonidae | | | | | | | | | | | | |
| Platybelone argalus platyura | | | | | | | | | | | | |
| Strongylura incisa | | | | | | | | | | | | |
| Fam. Hemiramphidae | | | | | | | | | | | | |
| Hemiramphus sp. | | | | | | | | | | | | |
| Fam. Haemulidae | | | | | | | | | | | | |
| Diagramma pictum | | | | | | | | | | | | |
| Plectorhinchus chaetodontoides | | | | | | | | | | | | |
| Plectorhinchus gaterinoides | | | | | | | | | | | | |
| Plectorhinchus goldmanni | | | | | | | | | | | | |
| Plectorhinchus orientalis | | | R | R | | | | | | | | |
| Plectorhinchus gibbosus | | | | | | | | | | | | |
| Plectorhinchus pictus | | | | | | | | | | O | | |
| Fam. Plotosidae | | | | | | | | | | | | |
| Plotosus lineatus | | | | | | | | | | | | |
| Fam. Holocentridae | | | | | | | | | | | | |
| Myripristis adustus | O | O | | | C | | | | C | O | O | |
| Myripristis berndti | | | | | | | C | | | | | |
| Myripristis kuntee | | | | | | | | | | | | |
| Myripristis murdjan | R | O | | | | | | | O | | | |
| Myripristis violacea | | O | O | | C | | | | C | C | | |
| Neoniphon opercularis | | | | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Neoniphon sammara | | | C | C | | | | | | | R |
| Sargocentron caudimaculatum | | | | | | R | | | O | | R |
| Sargocentron diadema | | | | | | | | | | | R |
| Sargocentron microstoma | | | | | | | | | | | |
| Sargocentron punctatissimum | | | | | | | | | | | |
| Sargocentron spiniferum | | | | | | | | | | | R |
| Fam. Aulostomidae | | | | | | | | | | | |
| Aulostomus chinensis | | | | | | | | | | | |
| Fam. Fistulariidae | | | | | | | | | | | |
| Fistularia commersonii | | | | | | | | | | | |
| Fam. Sygnathidae | | | | | | | | | | | |
| Corythoichthys intestinalis | | O | O | O | | | | | | | |
| Fam. Scorpaenidae | | | | | | | | | | | |
| Pterois antennata | | | | | | | | | | | |
| Pterois volitans | | | | | | | | | | | |
| Fam. Caracanthidae | | | | | | | | | | | |
| Caracanthus maculatus | | | | | | | | | | | |
| Fam. Serranidae | | | | | | | | | | | |
| Cephalopholis argus | O | | | | | R | O | O | R | O | |
| Cephalopholis urodeta | O | | | | O | | O | | | O | |
| Epinephelus fasciatus | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | |
| Epinephelus hexagonatus | | | | | | | | | | | |
| Epinephelus maculatus | | | | | | | | | | | |
| Epinephelus merra | | | | | | R | O | O | R | | O |
| Epinephelus microdon | | | | | | | | | | | |
| Epinephelus sp. | | | R | | | | | | | | |
| Epinephelus tauvina | | | | R | | | | | | | |
| Pseudanthias dispar | | | | | | | | | | A | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Pseudanthias pascalus | | | | | | | | | A | | |
| Plectropomus laevis | O | | | | | | | | | | |
| Plectropomus areolatus | | | | | | | | | | | |
| Variola louti | | | | | | | | | | | |
| Fam. Pseudochromidae | | | | | | | | | | | |
| Pseudochromis sp. | | | | | | | | | | | |
| Fam. Cirrhitidae | | | | | | | | | | | |
| Paracirrhitus arcatus | R | | | | | | | | | R | |
| Paracirrhitus forsteri | | | | | | | | | R | | |
| Fam. Kuhliidae | | | | | | | | | | | |
| Kuhlia mugil | | | | | | | | | | | |
| Fam. Grammistidae | | | | | | | | | | | |
| Belanoperca chaubanaudi | | | | | | | | | | | |
| Fam. Apogonidae | | | | | | | | | | | |
| Apogon amboinensis | | O | | | | | | | | | |
| Apogon cyanosoma | | | | | | | | | | | |
| Apogon sp. cf A. sangiensis | | | A | | | | | | | | |
| Apogon sp. cf A. exostigma | | | | | | | | | | | |
| Apogon fraenatus | | | | O | | | | | | | |
| Apogon leptacanthus | O | O | A | O | | | | | | | |
| Apogon novemfasciatus | | | | | | O | | | | | |
| Archamia fucata | | | A | | | | | | | | |
| Archamia zosterophora | | | A | | | | | | | | |
| Cheilodipterus macrodon | | | | | | | | | R | | |
| Cheilodipterus quinquelineata | O | O | A | O | | | | | | | O |
| Sphaeramia nematoptera | O | O | A | | | | | | | | |
| Sphaeramia orbicularis | | | | | | | | | | | |
| Fam. Malacanthidae | | | | | | | | | | | |
| Malacanthus latovittatus | | | | | | | | | | | |

YAP ISLANDS SPECIES LIST

| | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Carangidae | | | | | | | | | | | |
| Carangoides orthagrammus | | | | | | | | | | | |
| Caranx melampygus | | | | | | | O | | | | |
| Caranx sexfasciatus | A | | | | | | | | | | |
| Gnathanodon speciosus | | | | | | | | | | | |
| Trachinotus baillonii | | | | | | | | | | | |
| Trachinotus blochii | | | | | | | | | | | |
| Fam. Lutjanidae | | | | | | | | | | | |
| Aphareus furca | | R | | | | | O | | O | O | |
| Aprion virescens | | | | | | | | | | R | |
| Lutjanus bohar | A | | | | | | A | | O | O | |
| Lutjanus ehrenbergi | | | | R | | | | R | | | |
| Lutjanus fulvus | | O | O | O | | | | R | | | O |
| Lutjanus gibbus | A | O | | O | C | | O | | A | O | |
| Lutjanus kasmira | | | | | | | | | | | |
| Lutjanus monostigmus | | | | O | | C | | | | R | O |
| Lutjanus rivulatus | | | | | | | | | R | | |
| Macolor niger | C | | | | | | | | | | |
| Fam. Caesionidae | | | | | | | | | | | |
| Caesio caerulaurea | | O | | O | | | | | | | |
| Caesio cuning | | | | | | | | | | | |
| Caesio lunaris | | | | | | | | | | | |
| Caesio teres | | O | | | | | | | | | |
| Pterocaesio tile | A | | | | | | | | | A | |
| Caesio teres | | O | | | C | | | | | C | |
| Pterocaesio marri | | | | | | | | | | | |
| Pterocaesio pisang | | | | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Lethrinidae | | | | | | | | | | | |
| Gnathodentex aureolineatus | | O | | C | | | | | A | A | |
| Lethrinus amboinensis | | | | | | | | | | | |
| Lethrinus harak | | | | | | | | | | | |
| Lethrinus elongatus | | | | | | | | | | | |
| Lethrinus semicinctus | | O | | O | | | | | | | |
| Lethrinus ornatus | | | | | | | | | | | |
| Lethrinus sp. | | O | | | | | | | | | |
| Monotaxis grandoculis | R | C | | O | O | | O | | C | | |
| Fam. Nemipteridae | | | | | | | | | | | |
| Pentapodus macrurus | | | | | | | | | | | |
| Scolopsis bilineatus | | | | | | | | | | | |
| Scolopsis lineatus | | | | R | | | | | | | |
| Scolopsis ciliatus | | O | | O | | | | | | | R |
| Scolopsis cf. xenochrous | | | | | | | | | | | |
| Scolopsis trilineatus | | | | | | | | | | | |
| Fam. Gerreidae | | | | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | | | | |
| Fam. Mullidae | | | | | | | | | | | |
| Mulloides flavolineatus | | O | | | | | | | | | C |
| Mulloides vanicolensis | | | | | | | | | | | |
| Parupeneus barberinus | | O | | | | | | O | | | O |
| Parupeneus bifasciatus | | | | | R | | | O | O | | |
| Parupeneus ciliatus | | | | | | | | | | | |
| Parupeneus cyclostomus | | | | | R | | | | | | |
| Parupeneus indicus | | | | | | | | | R | | |
| Parupeneus multifasciatus | | R | | O | | | O | O | | | |
| Parupeneus pleurostigma | | | | | | | | | | | |
| Parupeneus sp. | | | | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | | | | |
| Upeneus vittatus | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Kyphosidae | | | | | | | | | | | |
| Kyphosus cinerascens | O | | | | | O | | | C | | |
| Kyphosus lembus | | | | | | O | | | | | |
| Kyphosus sp. | | | | | | | | | | | |
| Kyphosus vaigiensis | | | | | | | | | | | |
| Fam. Ephippidae | | | | | | | | | | | |
| Platax orbicularis | | | | | | | | | | | |
| Fam. Toxotidae | | | | | | | | | | | |
| Toxotes jactator | | | | | | | | | | | |
| Fam. Scatophagidae | | | | | | | | | | | |
| Scatophagus argus | | | | | | | | | | | |
| Fam. Chaetodontidae | | | | | | | | | | | |
| Chaetodon auriga | R | O | | O | | O | | O | R | | R |
| Chaetodon bennetti | | R | | | | | O | | O | | |
| Chaetodon citrinellus | O | O | | | | | R | C | | | |
| Chaetodon ephippium | R | O | O | O | | | | O | | | O |
| Chaetodon kleinii | O | O | O | | | | | | | | R |
| Chaetodon lineolatus | | R | | | C | | | | | O | |
| Chaetodon lunula | | | R | | | C | | | R | O | R |
| Chaetodon melannotus | O | O | R | | R | | | O | | | R |
| Chaetodon mertensii | | | | | | | | | O | | |
| Chaetodon meyeri | | | | | | | | | R | | |
| Chaetodon ornatissimus | R | R | | R | | | R | | | | |
| Chaetodon plebius | | | | O | | | | | | | R |
| Chaetodon punctatofasciatus | O | R | | | O | | O | | O | O | |
| Chaetodon rafflesii | | | | | | | | R | R | | |
| Chaetodon reticulatus | O | R | | | O | | O | | O | | |
| Chaetodon semeion | | | O | R | | | | | | | |
| Chaetodon trifascialis | O | O | | C | O | | O | C | O | O | |
| Chaetodon trifasciatus | C | O | O | C | O | | O | C | O | O | O |
| Chaetodon ulietensis | O | O | O | O | | | | | O | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Chaetodon unimaculatus | O | | | | | | R | | R | O | |
| Chaetodon vagabundus | O | O | | | | | | | | O | O |
| Forcipiger flavissimus | O | O | | | O | | R | | | | |
| Forcipiger longirostris | | R | | | R | | | | O | R | |
| Hemitaurichthys polylepis | A | | | | | | | | O | A | |
| Heniochus acuminatus | | | O | | | | | | O | | |
| Heniochus chrysostomus | | O | O | O | | | | O | | | |
| Heniochus monoceros | O | | | | | | O | | | O | |
| Heniochus varius | | R | | | | | | | O | | |
| Fam Pempheridídae | | | | | | | | | | | |
| Pempheris oualensis | | | | | C | | | | | | |
| Fam. Pomacanthidae | | | | | | | | | | | |
| Centropyge bicolor | | O | | | | | | | R | | |
| Centropyge bispinosus | | | | | | | | | | | |
| Centropyge flavissimus | | | | | | | | | | | |
| Centropyge heraldi | | | | | | | | | | | |
| Centropyge loriculus | | | | | | | | | | | |
| Centropyge nox | | | | | | | | | | | |
| Centropyge tibicen | | | | | | | | | | | |
| Centropyge vrolicki | O | O | | | | | | | | | |
| Pomacanthus imperator | | | | | | | | | | | |
| Pomacanthus sextriatus | | | | | | | | | | | |
| Pomacanthus xanthometopon | | | | | | | | | | | |
| Pygoplites diacanthus | O | O | | | | | | | O | R | R |
| Fam. Pomacentridae | | | | | | | | | | | |
| Abudefduf septemfasciatus | | | | | | C | | | | | |
| Abudefduf sexfasciatus | | C | | O | | O | | | | | C |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Abudefduf sordidus | | | | | | O | | | | | |
| Abudefduf sp. | | | | | | | | | | | |
| Abudefduf saxatilis | | | | | | | | | | | |
| Amblyglyphidodon aureus | | | C | | | | | | | | |
| Amblyglyphidodon curacao | | C | A | C | O | | | | C | | C |
| Amblyglyphidodon leucogaster | | | | | | | | | | | |
| Amblyglyphidodon ternatensis | | | | O | | | | | O | | |
| Amphiprion chrysopterus | | | | | | | | | | | |
| Amphiprion clarkii | | | | | | | | | R | | |
| Amphiprion melanopus | | | | | | | | | | | |
| Amphiprion peridaeraion | | | | | | | | | | | |
| Chromis agilis | | | | | | | | | | | |
| Chromis amboinensis | | | | | | | | | | | |
| Chromis atripectoralis | | | | | C | | | | | | |
| Chromis atripes | | | | | | | | | | | |
| Chromis viridis | | | C | A | | | | | | | |
| Chromis lepidolepis | C | R | | | | | | A | | | O |
| Chromis margaritifer | | O | | | A | | A | | A | A | |
| Chromis phillipinus | | | | | | | | | | | |
| Chromis sp. | | | | | | | | | | | |
| Chromis ternatensis | | O | C | | | | | | | | |
| Chromis vaiuli | | | | | | | | | | | |
| Chromis vanderbilti | | | | | | | | | | | |
| Chromis xanthura | | O | | | | | | | | | |
| Chrysiptera cyanea | | | | | | | | | | | |
| Chrysiptera glauca | | | | | | A | | | | | |
| Chrysiptera leucopoma | | | | | | A | | A | | | |
| Chrysiptera traceyi | | | | | | | | | | | |
| Dascyllus aruanus | | C | C | A | | | | | | | C |
| Dascyllus melanurus | | | | C | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Dascyllus reticulatus | C | C | | | | | C | | A | | |
| Dascyllus trimaculatus | O | O | | | R | | O | | C | | O |
| Dischistodus chrysopoecilus | | | | | | | | | | | |
| Dischistodus notopthalmus | | | | | | | | | | | |
| Dischistodus perspicillatus | | | | | | | | | | | |
| Hemiglyphidodon plagiometapon | | | R | | | | | | | | |
| Paraglyphidodon melas | | | | | | | | | | | |
| Plectroglyphidodon dickii | | | | | C | | C | C | C | O | |
| Plectroglyphidodon johnstonianus | | | | | | | | | | | |
| Plectroglyphidodon lacrymatus | | | | | C | | | O | O | | |
| Plectroglyphidodon leucozona | | | | | | A | | C | | | |
| Pomacentrus bankanensis | | | | | | | | | | | |
| Pomacentrus coelestis | | O | | | | | | C | | | C |
| Pomacentrus moluccensis | | | | | | O | | O | | | |
| Pomacentrus grammorhynchus | | | | R | | | | | | | |
| Pomacentrus pavo | | | O | | | | | | | | R |
| Pomancentrus phillipinus | | | | | | | | | | | |
| Pomacentrus sp. | | | C | R | | | | | | | |
| Pomacentrus vaiuli | O | O | | | | | O | | | O | |
| Stegastes albifasciatus | | | | | | | | O | | | |
| Stegastes fasciolatus | | | | | | | | | | | |
| Stegastes lividus | | O | | C | | | | O | | | |
| Stegastes nigricans | | | C | A | | | | C | | | C |
| Fam. Mugilidae | | | | | | | | | | | |
| Liza vaigiensis | | | | | | | | | | | |
| Valamugil engeli | | | | | | | | | | | |
| Valamugil sp. or seheli | | | | | | | | | | | |
| Fam. Sphyraenidae | | | | | | | | | | | |
| Sphyraena barracuda | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Labridae | R | | | | | | | | | | |
| Anampses caeruleopunctatus | | | | | | | | | R | | |
| Anampses melanurus | | | | | | | | | | | |
| Anampses meleagrides | | | | | | | | | | | |
| Anampses twisti | O | R | | O | | | | | R | O | |
| Bodianus axillaris | | | | | O | | R | | | R | |
| Bodianus bimaculatus or B.loxozona | | | | | | | | | | | |
| Cheilinus bimaculutus | | | | | | | | | | | |
| Cheilinus celebicus | | | | | | | | | | | |
| Cheilinus chlorourus | | | | | | | | | R | | |
| Cheilinus digrammus | | R | | | | | | | | | |
| Cheilinus fasciatus | R | | R | | | | | | O | | |
| Cheilinus trilobatus | | | | R | | | | O | | | |
| Cheilinus undulatus | R | | O | O | | | | O | | | R |
| Cheilinus unifasciatus | | | | | O | | R | | R | | |
| Cheilio inermis | | | | | | | | | | | |
| Choerodon anchorago | | | O | O | | | | | | | O |
| Cirrhilabrus n.sp.2 | | | | | | | | | | | R |
| Coris aygula | | | | | | | | | | | |
| Coris gaimardi | | R | | | | | | | | | |
| Diproctaconthus xanthurus | | | | R | | | | | | | |
| Epibulus insidiator | O | O | O | C | O | | R | O | O | O | O |
| Gomphosus varius | R | O | | O | R | | R | O | O | O | |
| Halichoeres biocellatus | | | | | | | | | | | |
| Halichoeres chrysus | | | | | | | | | | | |
| Halichoeres chloropterus | | | | | | | | | | | |
| Halichoeres hortulanus | O | O | | | O | | O | C | O | O | |
| Halichoeres margaritaceus | R | | | R | | C | | R | | | |
| Halichoeres sp. | | | | | | | | | | | |
| Halichoeres marginatus | | R | | | | | | | R | R | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Halichoeres melanurus | | | O | | | | | | | | |
| Halichoeres prosopeion | | R | | | | | | | | | |
| Halichoeres trimaculatus | | | | | | A | | C | | | C |
| Hemigymnus fasciatus | | | | O | | | | | | | |
| Hemigymnus melapterus | | | O | O | | | | R | R | O | O |
| Hologymnosus doliatus | | | | | | | R | | | | |
| Labrichthys unilineatus | | O | | C | | | | | | | |
| Labroides bicolor | | | | R | | | | | | | |
| Labroides dimidiatus | R | O | O | O | R | | R | O | R | | O |
| Labroides pectoralis | | | | | | | | | O | | |
| Labropsis xanthonota | | | | | | | | | R | | |
| Labropsis micronesica | | | | R | | | | | | | |
| Macropharyngodon meleagris | | | | | | | | | | | |
| Macropharyngodon negrosensis | | | | | | | | | | | |
| Novaculichthys taeniourus | | | | | | | | | | | |
| Pseudocheilinus evanidus | | | | | | | | | | | |
| Pseudocheilinus hexataenia | | O | | O | | | | | R | | |
| Stethojulis bandanensis | | O | | O | | | | C | | | O |
| Stethojulis strigiventor | | | | | | C | | | | | |
| Stethojulis trilineata | | | | | | R | | C | | | |
| Thalassoma amblycephalum | A | | C | | | | | C | | | |
| Thalassoma hardwickii | O | C | O | C | O | O | | C | O | | O |
| Thalassoma janseni | | | | | | | | | | | |
| Thalassoma lunare | | C | O | C | | | | | | O | C |
| Thalassoma lutescens | | | | | R | | O | | O | O | |
| Thalassoma purpureum | | | | | | | | | | | |
| Thalassoma quinquevittatum | C | | | | | | O | | | O | |
| Thalassoma trilobatum | | | | | | | | | | | |
| Xyrichthys pavo | | | | | | | | | | | |

Appendix b
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Scaridae | | | | | | | | | | | |
| Bolbometopon muricatum | | | | | | | R | | | O | |
| Calotomus carolinus sp.C.spinidens | | | | | | | | | | | |
| Cetoscarus bicolor | | | | R | | | | | | R | |
| Leptoscarus vaigiensis | | | | | | | | | | | |
| Scarus altipinnis | | | | | | | | | | | |
| Scarus atropectoralis | R | | | | | | | | | | |
| Scarus dimidiatus | | O | O | | | | | | | | C |
| Scarus forsteni | | | | | R | R | | O | R | | |
| Scarus frenatus | R | | | | R | | | | | | |
| Scarus frontalis | | | | | | | R | | | | |
| Scarus ghobban | | O | | O | | | | | | | |
| Scarus gibbus | | C | O | | O | | O | | | | |
| Scarus globiceps | | | | | | | | O | | | |
| Scarus javanicus | | | | | | | R | | | | |
| Hipposcarus longiceps | R | | | | R | | | | R | O | |
| Scarus niger | | | O | | | | | R | O | C | |
| Scarus oviceps | | O | C | | O | | O | C | O | O | |
| Scarus prasiognathus | | | | | | | | | | R | R |
| Scarus psittacus | | | | | R | | | | | O | |
| Scarus quoyi | | | | | | | | | | | |
| Scarus rubroviolaceus | | | | | | | | | R | | |
| Scarus schlegeli | O | R | | | | | | O | O | | |
| Scarus sordidus | O | C | C | C | O | | O | A | O | O | C |
| Scarus sp. (juv.) | | C | A | A | | O | | A | | | |
| Scarus spinus | | | | | | | | | | | |
| Scarus spp. (adult) | | R | R | | | | | | | | |
| Scarus spp. (juv.) | | | | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Mugiloididae | | | | | | | | | | | |
| Parapercis millipunctata | | | | | | | | | | | |
| Parapercis clathrata | | | | | | | | | | | |
| Fam. Trichonotidae | | | | | | | | | | | |
| Trichonotus(?) | | | | | | | | | | | |
| Fam. Blenniidae | | | | | | | | | | | |
| Aspidontus taeniatus | | | | | | | | R | | | |
| Exalias brevis | | | | | | | | | | | |
| Istiblennius lineatus | | | | | | | | | | | |
| Meiacanthus atrodorsalis | | | | O | | | | | | | |
| Meiacanthus grammistes | | O | O | O | | | | | | | R |
| Plagiotremus rhynorhynchus | | | | | | | | | | | |
| Plagiotremus tapeinosoma | O | | | | | | | | | | |
| Fam. Gobiidae | | | | | | | | | | | |
| Acentrogobius sp. | | | | | | | | | | | |
| Amblygobius phalaena | | | | | | | | | | | |
| Asterropteryx semipunctatus | | | | | | | | | | | C |
| Bathygobius fuscus | | | | | | | | | | | |
| Bathygobius youngei | | | | | | | | | | | |
| Eviota sp. | | | O | | | | | | | | |
| Exyrias puntang | | R | | | | | | | | | |
| Cryptocentrus sp. | | | | | | | | | | | |
| Goby sp. (with shrimp) | | | | | | | | | | | |
| Goby sp. | | O | | | | | | | | | |
| Gobiodon sp. cf. G. okinawae | | | | | | | | | | | |
| Istigobius rigilius | | | | | | | | | | | |
| Oplopomus oplopomus | | | | | | | | | | | |
| Valenciennea strigatus | | | | | | | | | | | |

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Fam. Microdesmidae | | | | | | | | | | | |
| Nemateleotris magnifica | | | | | C | | | | | | |
| Ptereleotris evides | | | | | | | | | | | |
| Ptereleotris sp. | | | | | | | | | | | |
| Ptereleotris tricolor | | R | | | | | | | | | |
| Fam. Callionymidae | | | | | | | | | | | |
| Callionymus sp. | | | | | | | | | | | |
| Fam. Acanthuridae | | | | | | | | | | | |
| Acanthurus achilles | | | | | | | | | | | |
| Acanthurus chronixis | | R | | | | | | | | | |
| Acanthurus dussumieri | R | | | | | | | | | | |
| Acanthurus nigricans | C | O | | O | C | | O | | O | O | O |
| Acanthurus guttatus | | | | | | | | | | | |
| Acanthurus lineatus | | | | | | | | C | | | |
| Acanthurus blochii | | | O | O | | | O | C | | | O |
| Acanthurus nigricauda | | | | | | | | | | | |
| Acanthurus nigrofuscus | O | C | | C | O | | | A | | | |
| Acanthurus nigroris | | | | | | | | | | | |
| Acanthurus olivaceus | | | | | R | | | O | R | | |
| Acanthurus pyroferus | O | | | | | | R | O | O | | |
| Acanthurus thompsoni | | | | | | | R | | O | | |
| Acanthurus triostegus | | | | | | C | | C | | | |
| Acanthurus xanthopterus | | C | R | C | | | | C | | | |
| Ctenochaetus binotatus | | O | O | | | | R | | | | |
| Ctenochaetus hawaiiensis | | | | | | | | | | | |
| Ctenochaetus striatus | C | C | O | | C | | O | A | O | C | C |
| Ctenochaetus strigosus | | | | | | | | | | | |
| Naso annulatus | | | | | R | | | | | | |
| Naso brevirostris | | | O | | | | | | | C | |
| Naso hexacanthus | | | | | O | | | | | O | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YORI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Naso lituratus | O | R | | | O | | | | O | O | |
| Naso lopezi | | | | | | | | | | | |
| Naso thynnoides | | | | | | | | | R | | |
| Naso tuberosus | | | | | | | O | | | | |
| Naso unicornis | | | | | | | | | | | |
| Naso vlamingii | | | | | | | | | R | C | |
| Zebrasoma flavescens | | | | | | | | | | | |
| Zebrasoma scopas | C | C | O | C | C | | | C | C | | |
| Zebrasoma veliferum | R | | C | O | | | O | | O | | O |
| Fam. Zanclidae | | | | | | | | | | | |
| Zanclus cornutus | O | O | O | O | O | | O | O | O | O | O |
| Fam. Siganidae | | | | | | | | | | | |
| Siganus argenteus | | | | | | | | | | | |
| Siganus corallinus | | | O | | | | | | | | |
| Siganus canaliculatus | | | | | | | | | | | |
| Siganus doliatus | | | O | O | | | | | | | |
| Siganus puellus | | | O | O | | | | | R | | |
| Siganus vulpinus | | | O | | O | | | | | | |
| Siganus lineatus | | | | R | | | | | | | |
| Siganus spinus | | | | | | | | | | | |
| Fam. Bothidae | | | | | | | | | | | |
| Bothus sp. | | | | | | | | | | | |
| Fam. Balistidae | | | | | | | | | | | |
| Balistapus undulatus | | O | | | O | | O | | O | R | |
| Balistoides conspicillum | | | | | | | | | | | |
| Balistoides viridescens | | | | | | | | | | | |
| Melichthys niger | | | | | | | R | | | O | |
| Melichthys vidua | O | | | | O | | O | | O | O | |
| Pseudobalistes flavimarginatus | | | | | | | | | | | |
| Rhinecanthus aculeatus | | | | | | | | | | | O |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Rhinecanthus rectangulus | | | | | | | | | | | |
| Rhinecanthus verrucosa | | | | | | R | | | | | |
| Sufflamen bursa | | | | | | | | | | | |
| Sufflamen chrysoptera | | | | | | | | R | | | R |
| Fam. Monacanthidae | | | | | | | | | | | |
| Aluterus scriptus | | | | | | | | | | | |
| Amanses scopas | | | | | | | | | | | |
| Cantherhines pardalis | | | | | | | | | | | |
| Cantherhines dumerilii | | | | | | | | | R | | |
| Oxymonacanthus longirostris | | | | | | | | O | O | O | |
| Paraluteres prionurus | | | | | | | | | | | |
| Pervagor sp. | | | | | | | R | | | | |
| Fam. Ostraciontidae | | | | | | | | | | | |
| Lactoria cornuta | | | | | | | | | | | |
| Ostracion cubicus | | | | | | | | | | | |
| Ostracion meleagris | | | | | | | | | | | R |
| Fam. Tetraodontidae | | | | | | | | | | | |
| Arothron hispidus | | | | | | | | | | | |
| Arothron manilensis | | | | | | | | | | | |
| Arothron meleagris | | | | | | | | | | | |
| Arothron stellatus | | | | | | | | | | | |
| Canthigaster amboinensis | | | | | | | | | | | |
| Canthigaster bennetti | | | | | | | | | | | |
| Canthigaster solandri | | | | | | | | | | | |
| Canthigaster valentini | | R | | | | | | | R | | R |
| Fam. Diodontidae | | | | | | | | | | | |
| Diodon hystrix | | | | | | | | R | | | |
| | | | | | | | | | | | |
| Class Reptilia | | | | | | | | | | | |
| Order Testudines | | | | | | | | | | | |
| Fam. Cheloniidae | | | | | | | | | | | |
| Chelonia mydas | | | | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 7 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c | |
| FISH | | | | | | | | | |
| PHYLUM CHORDATA | | | | | | | | | |
| Fam. Carcharhinidae | | | | | | | | | |
| Carcharhinus albimarginatus | | | | | | | | | |
| Carcharhinus amblyrhynchos | | | | | | | | | |
| Carcharhinus melanopterus | | | | | | | | | |
| Fam. Hemigaleidae | | | | | | | | | |
| Triaenodon obesus | | | | | | | | | |
| Fam. Orectolobidae | | | | | | | | | |
| Nebrius concolor | | | | | | | | | |
| Fam. Dasyatididae | | | | | | | | | |
| Dasyatis kuhlii | | | | | | | | | |
| Stingray | | | | | | | | | |
| Fam. Urolophidae | | | | | | | | | |
| Urolophus sp. | | | | | | | | | |
| Fam. Mobulidae | | | | | | | | | |
| Manta alfredi | | | | | | | | | |
| Manta sp. | | | | | | | | | |
| Fam. Myliobatidae | | | | | | | | | |
| Aetobatus narinari | | | | | | | | | |
| Fam. Muraenidae | | | | | | | | | |
| Echidna nebulosa | | | R | | | | | | |
| Gymnothorax javanicus | | | | | | | | | |
| Gymnothorax flavimarginatus | | | | | | | | | |
| Gymnothorax meleagris | | | | | | | | | |
| Siderea picta | | | | | | | | | |
| Fam. Clupeidae | | | | | | | | | |
| Spratelloides delicatulus | | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Fam. Synodontidae | | | | | | | | |
| Saurida gracilis | | | | | | | | |
| Synodus sp. | | | | | | | | |
| Synodus variegatus | | | | | | | | |
| Fam. Chanidae | | | | | | | | |
| Chanos chanos | | | | | | | | |
| Fam. Belonidae | | | | | | | | |
| Platybelone argalus platyura | | | | | | | | |
| Strongylura incisa | | | | | | | | |
| Fam. Hemiramphidae | | | | | | | | |
| Hemiramphus sp. | | | | | | | | |
| Fam. Haemulidae | | | | | | | | |
| Diagramma pictum | | | | | | | | |
| Plectorhinchus chaetodontoides | | | | | | | | |
| Plectorhinchus gaterinoides | | | | | | | | |
| Plectorhinchus goldmanni | | | | | | | | |
| Plectorhinchus orientalis | | | | | | | | |
| Plectorhinchus gibbosus | | | | | | | | |
| Plectorhinchus pictus | | | | | R | | | |
| Fam. Plotosidae | | | | | | | | |
| Plotosus lineatus | | | | | | | | |
| Fam. Holocentridae | | | | | | | | |
| Myripristis adustus | | C | | | C | | | O |
| Myripristis berndti | | O | | | | | | |
| Myripristis kuntee | | | | | | | | |
| Myripristis murdjan | | | | | O | | | |
| Myripristis violacea | | | | | | O | | |
| Neoniphon opercularis | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Neoniphon sammara | | O | | | | | | |
| Sargocentron caudimaculatum | O | | | | | | | |
| Sargocentron diadema | | | | | | | | |
| Sargocentron microstoma | | | | R | | | | |
| Sargocentron punctatissimum | | | | | | | | |
| Sargocentron spiniferum | O | | | | | | | |
| Fam. Aulostomidae | | | | | | | | |
| Aulostomus chinensis | R | | | | | | | |
| Fam. Fistulariidae | | | | | | | | |
| Fistularia commersonii | | | | | | | R | |
| Fam. Sygnathidae | | | | | | | | |
| Corythoichthys intestinalis | | | | | | | O | |
| Fam. Scorpaenidae | | | | | | | | |
| Pterois antennata | | | | | | | | |
| Pterois volitans | | | | | | | | |
| Fam. Caracanthidae | | | | | | | | |
| Caracanthus maculatus | | | | | | | | |
| Fam. Serranidae | | | | | | | | |
| Cephalopholis argus | | R | | | O | | | |
| Cephalopholis urodeta | | | | O | | | | |
| Epinephelus fasciatus | | | | | | | | |
| Epinephelus maculatus | | | | | | | | |
| Epinephelus hexagonatus | | | | | | | | |
| Epinephelus maculatus | | | | | | | | |
| Epinephelus merra | O | | O | O | | O | R | |
| Epinephelus microdon | | | | R | | | | |
| Epinephelus sp. | | | | | | | | |
| Epinephelus tauvina | | | | | | | | |
| Pseudanthias dispar | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Pseudanthias pascalus | | | | | | | | |
| Plectropomus laevis | | | | | | | | |
| Plectropomus areolatus | | | | | | | | |
| Variola louti | | | | | | | | |
| Fam. Pseudochromidae | | | | | | | | |
| Pseudochromis sp. | | | | | | | | |
| Fam. Cirrhitidae | | | | | | | | |
| Paracirrhitus arcatus | | | | | | | | |
| Paracirrhitus forsteri | | | | | | | | |
| Fam. Kuhliidae | | | | | | | | |
| Kuhlia mugil | | | | | | | | |
| Fam. Grammistidae | | | | | | | | |
| Belanoperca chaubanaudi | | | | | | | | |
| Fam. Apogonidae | | | | | | | | |
| Apogon amboinensis | | | | | | | | |
| Apogon cyanosoma | | | | | | | | |
| Apogon sp. cf A. sangiensis | | | | | | | | R |
| Apogon sp. cf A. exostigma | | | | | | | | |
| Apogon fraenatus | | | | | | | | |
| Apogon leptacanthus | | | | | | | | |
| Apogon novemfasciatus | | | | | | | | |
| Archamia fucata | | | | | | | | |
| Archamia zosterophora | | | | | | | | |
| Cheilodipterus macrodon | | | | | | | | |
| Cheilodipterus quinquelineata | O | | C | O | | O | O | O |
| Sphaeramia nematoptera | | | C | O | | | R | O |
| Sphaeramia orbicularis | | | | | | | | |
| Fam. Malacanthidae | | | | | | | | |
| Malacanthus latovittatus | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Fam. Carangidae | | | | | | | | |
| Carangoides orthagrammus | | | | | | | | |
| Caranx melampygus | | | O | | | | | |
| Caranx sexfasciatus | | | | | | | | |
| Gnathanodon speciosus | | | | | | | | |
| Trachinotus baillonii | | | | | | | | |
| Trachinotus blochii | | | | | | | | |
| Fam. Lutjanidae | | | | | | | | |
| Aphareus furca | | R | | | O | R | | |
| Aprion virescens | | | | | | | | |
| Lutjanus bohar | | R | | | | | | |
| Lutjanus ehrenbergi | | | | | | | | |
| Lutjanus fulvus | | | | | R | C | | |
| Lutjanus gibbus | C | | R | | O | C | | |
| Lutjanus kasmira | | | | | | | | |
| Lutjanus monostigmus | O | R | | | | O | | |
| Lutjanus rivulatus | | | | | | | | |
| Macolor niger | | O | | | O | O | | |
| Fam. Caesionidae | | | | | | | | |
| Caesio caerulaurea | | | | | | | | |
| Caesio cuning | | | | | | | | |
| Caesio lunaris | | O | | | | | | |
| Caesio teres | | | | | | | | |
| Pterocaesio tile | | | | | A | | | |
| Caesio teres | | C | | | C | | | |
| Pterocaesio marri | | | | | | | | |
| Pterocaesio pisang | | | | | | | C | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Fam. Lethrinidae | | | | | | | | |
| Gnathodentex aureolineatus | | | | | | C | C | |
| Lethrinus amboinensis | | | | | | | | |
| Lethrinus harak | | | R | | | | | |
| Lethrinus elongatus | | | | | | | | |
| Lethrinus semicinctus | | | | | | | | |
| Lethrinus ornatus | | | | | | | | |
| Lethrinus sp. | | | | | | | | |
| Monotaxis grandoculis | | C | | O | | A | | |
| Fam. Nemipteridae | | | | | | | | |
| Pentapodus macrurus | | | | | | | | |
| Scolopsis bilineatus | | | | | | | | |
| Scolopsis lineatus | | | | | | | | |
| Scolopsis ciliatus | | | | | | | R | O |
| Scolopsis cf. xenochrous | | | | | | R | | O |
| Scolopsis trilineatus | | | | | | | | |
| Fam. Gerreidae | | | | | | | | |
| Gerres c.f. oblongus | | | | | | | | |
| Fam. Mullidae | | | | | | | | |
| Mulloides flavolineatus | C | | | | | C | O | |
| Mulloides vanicolensis | | | | | | | | |
| Parupeneus barberinus | R | | | O | | O | O | |
| Parupeneus bifasciatus | | | | | | | | |
| Parupeneus ciliatus | | | | | | | | |
| Parupeneus cyclostomus | R | | | | | | | |
| Parupeneus indicus | | | | | | | | |
| Parupeneus multifasciatus | O | R | | | R | | O | O |
| Parupeneus pleurostigma | | | | | | | | |
| Parupeneus sp. | | | | | | | | |
| Upeneus taeniopterus | | | | | | | | |
| Upeneus vittatus | | | | | | | | |

Appendix b
(cont'd)

## Conspicuous fish species observed during the YORI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Fam. Kyphosidae | | | | | | | | |
| Kyphosus cinerascens | O | O | | | | R | | |
| Kyphosus lembus | | | | | | | | |
| Kyphosus sp. | | | | | | | | |
| Kyphosus vaigiensis | | | | | | | | |
| Fam. Ephippidae | | | | | | | | |
| Platax orbicularis | | | | | | | | |
| Fam. Toxotidae | | | | | | | | |
| Toxotes jactator | | | | | | | | |
| Fam. Scatophagidae | | | | | | | | |
| Scatophagus argus | | | | | | | | |
| Fam. Chaetodontidae | | | | | | | | |
| Chaetodon auriga | R | O | R | R | R | O | O | O |
| Chaetodon bennetti | | | | | | | | |
| Chaetodon citrinellus | | | | | | O | O | |
| Chaetodon ephippium | O | | O | O | R | O | O | O |
| Chaetodon kleinii | R | O | | | O | R | O | |
| Chaetodon lineolatus | | | | | R | | | |
| Chaetodon lunula | | | | | | | | |
| Chaetodon melannotus | R | | | | O | R | | |
| Chaetodon mertensii | | | | | | R | | |
| Chaetodon meyeri | | | | | | | | |
| Chaetodon ornatissimus | | O | | | | R | | |
| Chaetodon plebius | | | | | | | | |
| Chaetodon punctatofasciatus | | O | | | O | | | |
| Chaetodon rafflesii | | R | | | | | | |
| Chaetodon reticulatus | R | O | | | O | O | | |
| Chaetodon semeion | | | | | | | O | |
| Chaetodon trifascialis | R | O | R | | O | O | O | |
| Chaetodon trifasciatus | O | O | O | O | O | O | O | |
| Chaetodon ulietensis | O | | | O | O | O | | R |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Chaetodon unimaculatus | | | | | | | | |
| Chaetodon vagabundus | | | | | | | | |
| Forcipiger flavissimus | | | | O | O | R | | |
| Forcipiger longirostris | | | | | R | | | |
| Hemitaurichthys polylepis | | A | | | A | | | |
| Heniochus acuminatus | | | | | | | | |
| Heniochus chrysostomus | O | | | O | | O | | |
| Heniochus monoceros | | | | | O | | | |
| Heniochus varius | | O | | | | | | |
| Fam Pempheridídae | | | | | | | | |
| Pempheris oualensis | | O | | | | | | |
| Fam. Pomacanthidae | | | | | | | | |
| Centropyge bicolor | | R | | | | O | O | |
| Centropyge bispinosus | | | | | R | | | |
| Centropyge flavissimus | | | | | | | | |
| Centropyge heraldi | | | | | | | | |
| Centropyge loriculus | | | | | | | | |
| Centropyge nox | | | | | | | | |
| Centropyge tibicen | | | | | | | | |
| Centropyge vrolicki | R | R | | | | R | | |
| Pomacanthus imperator | | | | | | | | |
| Pomacanthus sextriatus | | | | | | | | |
| Pomacanthus xanthometopon | | | | | | | | |
| Pygoplites diacanthus | R | R | | R | | | | |
| Fam. Pomacentridae | | | | | | | | |
| Abudefduf septemfasciatus | | | | | | | | |
| Abudefduf sexfasciatus | | A | | | | | | R |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Abudefduf sordidus | | | | | | | | |
| Abudefduf sp. | | | | | | | | |
| Abudefduf saxatilis | | | | | | | | |
| Amblyglyphidodon aureus | | | | | | | | |
| Amblyglyphidodon curacao | C | | | C | C | A | C | O |
| Amblyglyphidodon leucogaster | | O | | | R | | O | |
| Amblyglyphidodon ternatensis | | | | R | R | | | |
| Amphiprion chrysopterus | | | | | | | | |
| Amphiprion clarkii | | R | | | O | | | |
| Amphiprion melanopus | | | | | | | | |
| Amphiprion peridaeraion | | | | | | | | |
| Chromis agilis | | | | | | | | |
| Chromis amboinensis | | | | | | | | |
| Chromis atripectoralis | | A | | C | R | C | | |
| Chromis atripes | | | | | R | | | |
| Chromis viridis | A | | C | C | | A | C | |
| Chromis lepidolepis | C | | | O | | A | | |
| Chromis margaritifer | | A | | | A | | | |
| Chromis phillipinus | | | | | | | | |
| Chromis sp. | | | | | | | | |
| Chromis ternatensis | | A | | | A | A | | |
| Chromis vaiuli | | | | | | | | |
| Chromis vanderbilti | | | | | | | | |
| Chromis xanthura | | | | | | | | |
| Chrysiptera cyanea | O | | | O | | O | | |
| Chrysiptera glauca | | | | | | | | |
| Chrysiptera leucopoma | C | | C | | | | | |
| Chrysiptera traceyi | | | | | | | | |
| Dascyllus aruanus | C | | C | C | | O | C | |
| Dascyllus melanurus | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Dascyllus reticulatus | C | C | | | O | O | | |
| Dascyllus trimaculatus | | | | O | | O | O | |
| Dischistodus chrysopoecilus | | | | | | | | |
| Dischistodus notopthalmus | C | | C | | | O | R | |
| Dischistodus perspicillatus | O | | O | | | | | O |
| Hemiglyphidodon plagiometapon | | | | O | | | | |
| Paraglyphidodon melas | | | | | | | | |
| Plectroglyphidodon dickii | | O | | | | O | | |
| Plectroglyphidodon johnstonianus | | | | | | | | |
| Plectroglyphidodon lacrymatus | O | O | | | C | O | | |
| Plectroglyphidodon leucozona | | | | | | | | O |
| Pomacentrus bankanensis | R | | | | | | | |
| Pomacentrus coelestis | | | | | | O | | |
| Pomacentrus moluccensis | C | | | | | | | |
| Pomacentrus grammorhynchus | | | | | | | | |
| Pomacentrus pavo | C | | | O | | | | |
| Pomancentrus phillipinus | | | | | | | | |
| Pomacentrus sp. | | | C | | | | | |
| Pomacentrus vaiuli | | | | | O | | | |
| Stegastes albifasciatus | | | | | | C | | |
| Stegastes fasciolatus | | | | | | | | |
| Stegastes lividus | | | | | | C | | |
| Stegastes nigricans | A | | C | C | | | O | O |
| Fam. Mugilidae | | | | | | | | |
| Liza vaigiensis | | | | | | | | |
| Valamugil engeli | | | | | | | | |
| Valamugil sp. or seheli | | | | | | | | |
| Fam. Sphyraenidae | | | | | | | | |
| Sphyraena barracuda | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Fam. Labridae | | | | | | | | |
| Anampses caeruleopunctatus | | | | R | | | R | R |
| Anampses melanurus | | | | | | | | |
| Anampses meleagrides | | | | | R | | | |
| Anampses twisti | | | | | O | O | R | |
| Bodianus axillaris | | R | | | | | | |
| Bodianus bimaculatus or B.loxozona | | | | | | | | |
| Cheilinus bimaculutus | | | | | | | | |
| Cheilinus celebicus | | | | | | R | O | |
| Cheilinus chlorourus | | | | | | R | | |
| Cheilinus digrammus | R | | | R | | R | R | |
| Cheilinus fasciatus | R | R | | O | R | R | | |
| Cheilinus trilobatus | | | | | R | | | |
| Cheilinus undulatus | O | R | | | | R | | |
| Cheilinus unifasciatus | | | | | R | | | |
| Cheilio inermis | R | | C | | | | | |
| Choerodon anchorago | O | | O | R | | R | | O |
| Cirrhilabrus n.sp.2 | | | | | | O | | |
| Coris aygula | | | | | | | | |
| Coris gaimardi | | | | | | | | |
| Diproctaconthus xanthurus | | | | | | | | |
| Epibulus insidiator | O | R | R | O | R | O | O | |
| Gomphosus varius | O | O | | | O | O | O | |
| Halichoeres biocellatus | | | | | R | | | |
| Halichoeres chrysus | | | | | | | | |
| Halichoeres chloropterus | | | | | | | | C |
| Halichoeres hortulanus | O | O | | O | O | O | | R |
| Halichoeres margaritaceus | | | | | | | | |
| Halichoeres sp. | R | | | | | | | R |
| Halichoeres marginatus | | | | R | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Halichoeres melanurus | | | | | | | R | R |
| Halichoeres prosopeion | | | | | | | | |
| Halichoeres trimaculatus | C | | C | | | O | | |
| Hemigymnus fasciatus | | | | | O | | | |
| Hemigymnus melapterus | | | | O | | | O | |
| Hologymnosus doliatus | | | | | | | | |
| Labrichthys unilineatus | R | | | | | R | O | |
| Labroides bicolor | | R | | | | R | | |
| Labroides dimidiatus | O | | R | | O | O | O | |
| Labroides pectoralis | | | | | R | | | |
| Labropsis xanthonota | | | | | | | | |
| Labropsis micronesica | | | | | | | | |
| Macropharyngodon meleagris | | | | | | | | |
| Macropharyngodon negrosensis | | | | | | | | |
| Novaculichthys taeniourus | | | | | | | | |
| Pseudocheilinus evanidus | | | | | R | R | | |
| Pseudocheilinus hexataenia | R | R | | O | | O | O | |
| Stethojulis bandanensis | | | | O | | O | | |
| Stethojulis strigiventor | | | C | | | | | |
| Stethojulis trilineata | | | | | | R | | |
| Thalassoma amblycephalum | | | | O | | C | | |
| Thalassoma hardwickii | C | O | | | | O | O | O |
| Thalassoma janseni | | | | | | | | |
| Thalassoma lunare | | | | O | | | O | |
| Thalassoma lutescens | | R | | | O | | | |
| Thalassoma purpureum | | | | | | | | |
| Thalassoma quinquevittatum | | | | | O | | | |
| Thalassoma trilobatum | | | | | | | | |
| Xyrichthys pavo | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST — SECTION 7

| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Fam. Scaridae | | | | | | | | |
| Bolbometopon muricatum | | R | | | | | | |
| Calotomus carolinus sp.C.spinidens | | | | | | | | |
| Cetoscarus bicolor | | R | | R | | R | R | |
| Leptoscarus vaigiensis | | | A | | | | | |
| Scarus altipinnis | | | | | | | | |
| Scarus atropectoralis | | | | | | | | |
| Scarus dimidiatus | C | | | | | | | O |
| Scarus forsteni | | | R | | | | | |
| Scarus frenatus | | O | | | | | | |
| Scarus frontalis | | | | | | | | |
| Scarus ghobban | | R | | | | | | |
| Scarus gibbus | O | | | | | | | |
| Scarus globiceps | R | | | | | | | O |
| Scarus javanicus | | | | | | | | |
| Hipposcarus longiceps | | | | | | | | |
| Scarus niger | | O | | | O | R | O | |
| Scarus oviceps | O | O | | O | R | O | O | |
| Scarus prasiognathus | | | | | | | | |
| Scarus psittacus | | | | | | | | |
| Scarus quoyi | R | R | | | | | | |
| Scarus rubroviolaceus | | | | | | | | |
| Scarus schlegeli | O | O | | O | | O | | |
| Scarus sordidus | C | C | | C | O | C | C | O |
| Scarus sp. (juv.) | A | | A | C | | A | C | |
| Scarus spinus | | R | | O | R | | | |
| Scarus spp. (adult) | | | | O | | | | |
| Scarus spp. (juv.) | | | | | | | | |

Appendix B
(cont'd)

Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Fam. Mugiloididae | | | | | | | | |
| Parapercis millipunctata | | | | | | | | |
| Parapercis clathrata | | | | | | | | |
| Fam. Trichonotidae | | | | | | | | |
| Trichonotus(?) | | | | | | | | |
| Fam. Blenniidae | | | | | | | | |
| Aspidontus taeniatus | | | | | | R | | |
| Exalias brevis | | | | | | | | |
| Istiblennius lineatus | | | | | | R | | |
| Meiacanthus atrodorsalis | O | | | R | | O | | |
| Meiacanthus grammistes | | | | O | | | | |
| Plagiotremus rhynorhynchus | | | | | | | | |
| Plagiotremus tapeinosoma | | | | R | | | | |
| Fam. Gobiidae | | | | | | | | |
| Acentrogobius sp. | | | A | | | | | A |
| Amblygobius phalaena | | | A | | | | | A |
| Asterropteryx semipunctatus | | | D | | | | | |
| Bathygobius fuscus | | | O | | | | | |
| Bathygobius youngei | | | | R | | | | |
| Eviota sp. | | | | | | | | |
| Exyrias puntang | | | | | | R | O | |
| Cryptocentrus sp. | | | | | | | | O |
| Goby sp. (with shrimp) | | | O | | | | | C |
| Goby sp. | | | O | | | | | A |
| Gobiodon sp. cf. G. okinawae | | | | | | | R | |
| Istigobius rigilius | | | | | | | | |
| Oplopomus oplopomus | | | | | | | | |
| Valenciennea strigatus | | | | | | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c | |
| Fam. Microdesmidae | | | | | | | | | |
| Nemateleotris magnifica | | | | | | | | | |
| Ptereleotris evides | O | | | | O | R | O | | |
| Ptereleotris sp. | | | | | | | | | |
| Ptereleotris tricolor | | | | | | | | | |
| Fam. Callionymidae | | | | | | | | | |
| Callionymus sp. | | | | | | | | | |
| Fam. Acanthuridae | | | | | | | | | |
| Acanthurus achilles | | | | | | | | | |
| Acanthurus chronixis | | | | | | R | | | |
| Acanthurus dussumieri | | | | | | | | | |
| Acanthurus nigricans | O | A | | C | C | O | | | |
| Acanthurus guttatus | | | | | | | | | |
| Acanthurus lineatus | | | | | | | | | |
| Acanthurus blochii | O | | | | | | | C | |
| Acanthurus nigricauda | | | | | | | | | |
| Acanthurus nigrofuscus | O | | | C | | C | | | |
| Acanthurus nigroris | | | | | | | | | |
| Acanthurus olivaceus | | | | | | | | | |
| Acanthurus pyroferus | | | | | | O | | | |
| Acanthurus thompsoni | | | | | | | | | |
| Acanthurus triostegus | | | | | | C | | O | |
| Acanthurus xanthopterus | O | | | O | O | O | | R | |
| Ctenochaetus binotatus | | | | | | C | C | | |
| Ctenochaetus hawaiiensis | | | | | | | | | |
| Ctenochaetus striatus | | C | | C | C | C | | C | |
| Ctenochaetus strigosus | | | | | | | | | |
| Naso annulatus | | | | | | | | | |
| Naso brevirostris | R | A | | | | | | | |
| Naso hexacanthus | | | | | | R | | | |

Appendix B
(cont'd)

## Conspicuous fish species observed during the YCRI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Naso lituratus | C | O | | | R | O | O | |
| Naso lopezi | | C | | | O | | | |
| Naso thynnoides | | | | | | | | |
| Naso tuberosus | | | | | | | | |
| Naso unicornis | | | | | | | | |
| Naso vlamingii | | | | | | | | |
| Zebrasoma flavescens | | | | | | | | |
| Zebrasoma scopas | O | O | | O | C | C | C | |
| Zebrasoma veliferum | O | | | | R | | O | O |
| Fam. Zanclidae | | | | | | | | |
| Zanclus cornutus | C | O | | O | | O | O | O |
| Fam. Siganidae | | | | | | | | |
| Siganus argenteus | | | | | | | | |
| Siganus corallinus | R | | | | | O | O | |
| Siganus canaliculatus | | | | | | | | |
| Siganus doliatus | | | | O | | R | O | |
| Siganus puellus | | | | O | | O | O | |
| Siganus vulpinus | | | | | R | | | |
| Siganus lineatus | | | | | | | | |
| Siganus spinus | | | | | | | | |
| Fam. Bothidae | | | | | | | | |
| Bothus sp. | | | | | | | | |
| Fam. Balistidae | | | | | | | | |
| Balistapus undulatus | R | | | | O | O | | |
| Balistoides conspicillum | | | | | | | | |
| Balistoides viridescens | | | | | | R | | |
| Melichthys niger | | R | | | | | | |
| Melichthys vidua | | | | | O | | | |
| Pseudobalistes flavimarginatus | | | | | R | | | |
| Rhinecanthus aculeatus | | | R | | | | R | O |

## Conspicuous fish species observed during the YORI survey.

| YAP ISLANDS SPECIES LIST | SECTION 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STATION No. | 16a | 16 | 16b | 17a | 17 | 18a | 18b | 18c |
| Rhinecanthus rectangulus | | | | | | | | |
| Rhinecanthus verrucosa | | | | | | | | |
| Sufflamen bursa | | | | | | | | |
| Sufflamen chrysoptera | | | | | | | | |
| Fam. Monacanthidae | | | | | | | | |
| Aluterus scriptus | | | | | R | | | |
| Amanses scopas | | R | | | | | | |
| Cantherhines pardalis | | | | | | | | |
| Cantherhines dumerilii | | | | | | | | |
| Oxymonacanthus longirostris | | O | | | O | | | |
| Paraluteres prionurus | R | | | O | | | | |
| Pervagor sp. | | | | | | | | |
| Fam. Ostraciontidae | | | | | | | | |
| Lactoria cornuta | | | | | | | | |
| Ostracion cubicus | | | | | | | | |
| Ostracion meleagris | | | | R | | | | |
| Fam. Tetraodontidae | | | | | | | | |
| Arothron hispidus | | | | | | | | |
| Arothron manilensis | | | | | | | | |
| Arothron meleagris | | | | | | | | |
| Arothron stellatus | | | | | | | | |
| Canthigaster amboinensis | | | | | | | | |
| Canthigaster bennetti | | | | | | | | |
| Canthigaster solandri | | | | | | | | |
| Canthigaster valentini | R | | | | | | | |
| Fam. Diodontidae | | | | | | | | |
| Diodon hystrix | | | | | | | | |
| | | | | | | | | |
| Class Reptilia | | | | | | | | |
| Order Testudines | | | | | | | | |
| Fam. Cheloniidae | | | | | | | | |
| Chelonia mydas | | | | | | | | |

Appendix C:

Conspicuous benthic invertebrates observed in the Fanif sector.

| | 17 | 17A | 18 | 18A | 18D |
|---|---|---|---|---|---|
| **PORIFERA** | | | | | |
| cf. Cinachyra sp. | | C | | O | |
| Testillid sp. 1 | | O | | | |
| encrusting sponge, brown | | R | | | |
| black sponge | | O | | | O |
| brown sponge | | | | | O |
| Stylotella agminata | | C | | O | C |
| **CNIDARIA** | | | | | |
| Aglaophenia cupressina (Lamouroux) | | | | A | |
| Clavularia sp. | | A | | C | |
| Astrospicularia randalli Gawel | | | | | A |
| Lobophytum spp. | | | O | | |
| Sarcophyton sp. | | O | O | | R |
| Sinularia spp. | | | A | | |
| Xenia sp. | | | | | C |
| Sympodium coeruleum (Ehrenberg) | | | | O | |
| Heteractis magnifica (Quoy & Gaimard) | O | | R | | |
| Cirripathes sp. | | O | | | |
| **ANNELIDA** | | | | | |
| Sabellastarte sanctijosephi (Gravier) | | O | | O | |
| Spirobranchus giganteus (Pallas) | | | C | C | |
| **MOLLUSCA** | | | | | |
| Trochus niloticus (Linnaeus) | O | | | | |
| Dendropoma maxima (Sowerby) | | | | A | O |
| Strombus luhuanus (Linnaeus) | | | | | R |
| Lambis lambis (Linnaeus) | | R | | | |
| Cypraea tigris (Linnaeus) | | | | R | |
| Arca ventricosa (Lamarck) | | | | O | |
| Pedum spondyloideum (Gmelin) | | | | O | |
| Tridacna maxima (Roeding) | R | | O | | O |
| Hippopus hippopus (Linnaeus) | | | | | R |

| | 17 | 17A | 18 | 18A | 18D |
|---|---|---|---|---|---|
| **ECHINODERMATA** | | | | | |
| Linckia multifora (Lamarck) | | O | C | | |
| Acanthaster planci (Linnaeus) | | | | R | R |
| Echinostrephus cf. aciculatus A. Agassiz | R | | O | | |
| Bohadschia argus (Jaeger) | | | | R | |
| Holothuria atra (Jaeger) | | | | | O |
| Holothuria axiologa (H. L. Clark) | | | | R | |
| Thelenota ananas (Jaeger) | | O | | | |
| Thelenota anax (H. L. Clark) | | | | R | |
| Synapta maculata (Chamisso & Eysen.) | | R | | | |
| **CHORDATA** | | | | | |
| Didemnum molle (Herdman) | C | | | | A |
| Eudistoma cf. viride(Tokioka) | | A | | | |

Appendix C:

Conspicuous benthic invertebrates observed in the Gagil sector.

| | 6 | 6A | 7 | 7A | 7B | 8A | 8B |
|---|---|---|---|---|---|---|---|
| **PORIFERA** | | | | | | | |
| testillid sp. 1 | R | O | | | | | |
| Dysidea herbacea (Keller) | | | A | | | | |
| finger sponge, tan | C | | | | | | |
| black sponge | | A | C | R | | | O |
| brown sponge | | | O | | | | O |
| Stylotella agminata | A | | | O | C | | C |
| **CNIDARIA** | | | | | | | |
| Clavularia sp. | A | | C | A | A | | |
| Astrospicularia randalli (Gawel) | | | | A | A | | |
| Bellonella sp. | | | R | | | | |
| Cladiella sp. | | | R | | | | |
| Lobophytum spp. | | | R | O | | | |
| Sarcophyton sp. | | | O | | | | |
| Sinularia spp. | | | C | C | O | | C |
| Litophyton spp. | | | | O | | | |
| Stereonephthya spp. | | | | | | | A |
| Xenia sp. | C | | C | C | O | | |
| Sympodium coeruleum (Ehrenberg) | | | A | | | | |
| Sympodium sp. (yellow) | | | | A | A | | C |
| plexaurid sp. | R | | | | | | |
| Palythoa sp. | | | R | | | | |
| **ANNELIDA** | | | | | | | |
| Sabellastarte sanctijosephi (Gravier) | O | | | | | | C |
| Spirobranchus giganteus (Pallas) | C | | C | | | | R |
| **MOLLUSCA** | | | | | | | |
| Trochus niloticus (Linnaeus) | | | O | | | | |
| Nerita plicata (Linnaeus) | | | | | | C | |

| | 6 | 6A | 7 | 7A | 7B | 8A | 8B |
|---|---|---|---|---|---|---|---|
| Fissilabia decollata (Quoy & Gaimard) | | | | | | C | |
| Dendropoma maxima (Sowerby) | A | | | C | A | | C |
| Lambis lambis (Linnaeus) | | O | | | | | |
| Cypraea tigris (Linnaeus) | | | | O | R | | |
| Pinctada margaritifera (Linnaeus) | | | | | | | R |
| Pedum spondyloideum (Gmelin) | | O | | | | | |
| Tridacna maxima (Roeding) | | | O | | | | |
| **ARTHROPODA** | | | | | | | |
| Panulirus sp. | | | | | | | O |
| Dardanus megistos (Herbst) | | | O | | | | |
| **ECHINODERMATA** | | | | | | | |
| Culcita novaeguineae (Muller & Troschel) | | | | | | | O |
| Linckia laevigata (Linnaeus) | | | | O | | | |
| Linckia multifora (Lamarck) | | | O | | | | |
| Protoreaster nodosus (Linnaeus) | | A | | | | | |
| Acanthaster planci (Linnaeus) | | | O | | R | | |
| Echinaster leuzonicus (Gray) | | | | R | | | |
| Echinometra mathaei (de Blainville) | | R | | | | | |
| Echinostrephus cf. aciculatus (A. Agassiz) | | | O | | | | |
| Bohadschia argus (Jaeger) | R | | | R | O | | C |
| Bohadschia marmorata (Jaeger) | | O | | | | | |
| Holothuria atra (Jaeger) | | A | | O | O | | |
| Holothuria nobilis (Selenka) | | | | | | | R |
| Stichopus chloronotus (Brandt) | | | | R | O | | |
| **CHORDATA** | | | | | | | |
| Didemnum molle (Herdman) | | | O | | | | |

Appendix C:

Conspicuous benthic invertebrates observed in the Gilman sector.

| | 13 | 13A | 14 | 14A |
|---|---|---|---|---|
| **PORIFERA** | | | | |
| cf. Clathria cervicornis (Thiele) | | O | | |
| black sponge | | O | R | |
| brown sponge | | A | | |
| Stylotella agminata | | | | O |
| red sponge | | | R | |
| **CNIDARIA** | | | | |
| Lobophytum spp. | R | | R | |
| Sarcophyton sp. | R | | R | |
| Sinularia spp. | | | R | |
| Stereonephthya spp. | | | | O |
| Xenia sp. | | | | A |
| Heteractis magnifica (Quoy & Gaimard) | | | R | |
| Stichodactyla gigantea (Forsskal) | | C | | |
| **ANNELIDA** | | | | |
| Sabellastarte sanctijosephi (Gravier) | | | | R |
| **MOLLUSCA** | | | | |
| Dendropoma maxima Sowerby | | | | A |
| vermetid sp. | | A | | |
| Cypraea annulus (Linnaeus) | | O | | |
| Cypraea moneta (Linnaeus) | | O | | |
| Thais aculeata (Deshayes) | | O | | |
| Tridacna maxima (Roeding) | | | | C |
| Tridacna squamosa Lamarck | | | | R |
| Hippopus hippopus (Linnaeus) | | R | | R |
| Octopus sp. | | | R | |

| | 13 | 13A | 14 | 14A |
|---|---|---|---|---|
| **ARTHROPODA** | | | | |
| Thalassina sp. | | A | | |
| Grapsus sp. | | C | | |
| **ECHINODERMATA** | | | | |
| Comanthus cf. parvicirrus (J. Muller) | | | R | |
| Ophiocoma sp. | | O | | |
| Ophiomastix cf. annulosa (Lamarck) | R | | | |
| Culcita novaeguineae (Muller & Troschel) | | | | R |
| Linckia multifora (Lamarck) | | | R | |
| Acanthaster planci (Linnaeus) | R | | | |
| Echinothrix diadema (Linnaeus) | | | R | |

Appendix C:

Conspicuous benthic invertebrates observed in the Kanify sector.

| | 15 | 15A |
|---|---|---|
| **PORIFERA** | | |
| Dysidea herbacea (Keller) | O | |
| encrusting sponge, brown | | C |
| black sponge | R | |
| brown sponge | R | |
| Stylotella agminata | | A |
| **ANNELIDA** | | |
| Sabellastarte sanctijosephi (Gravier) | | R |
| **MOLLUSCA** | | |
| Trochus niloticus (Linnaeus) | C | |
| Tectus pyramis (Born) | R | |
| Turbo argyrostomus (Linnaeus) | O | |
| Arca ventricosa (Lamarck) | | O |
| Pinctada margaritifera (Linnaeus) | | R |
| Spondylus cf. squamosus (Schreibers) | | O |
| Tridacna maxima (Roeding) | O | |
| Tridacna squamosa (Lamarck) | O | |
| **ECHINODERMATA** | | |
| Culcita novaeguineae (Muller & Troschel) | | O |
| Linckia multifora (Lamarck) | O | |
| Echinaster callosus (von Marenzeller) | R | |
| Echinaster leuzonicus (Gray) | | O |
| Echinometra mathaei (de Blainville) | C | |
| Echinostrephus cf. aciculatus (A. Agassiz) | A | |

| | 15 | 15A |
|---|---|---|
| **CHORDATA** | | |
| Didemnum molle (Herdman) | A | A |
| Eudistoma cf. viride (Tokioka) | | A |
| Symplegma sp. | | A |

Appendix C:

Conspicuous benthic invertebrates observed in the Map sector.

| | 4 | 4A | 4B | 5 | 5A | 5B | 18B | 18C |
|---|---|---|---|---|---|---|---|---|
| PORIFERA | | | | | | | | |
| encrusting sponge, brown | | | | | | | A | O |
| encrusting sponge, gray | | | | | | | | C |
| black sponge | | | | | | A | C | C |
| brown sponge | | | | | | | O | |
| gray sponge | | | | | | | O | |
| Stylotella agminata | | | | | | | C | O |
| tan sponge, small | | | | | A | | | |
| CNIDARIA | | | | | | | | |
| Aglaophenia cupressina (Lamouroux) | | | | | | | O | |
| Clavularia sp. | | | | | | | O | |
| Lobophytum spp. | | R | | O | | | | |
| Sarcophyton sp. | C | | | | | C | | |
| Sinularia spp. | R | A | | O | | | A | |
| Xenia sp. | O | O | | O | | | | |
| Entacmaea quadricolor (Rueppell & Leuck.) | | | | | | | R | |
| Heteractis magnifica (Quoy & Gaimard) | R | | | R | | | | |
| Palythoa sp. | O | | | | | | | |
| Cirripathes sp. | | | | | | | | R |
| ANNELIDA | | | | | | | | |
| Sabellastarte sanctijosephi (Gravier) | | | | | | C | R | O |
| MOLLUSCA | | | | | | | | |
| Trochus maculatus (Linnaeus) | | R | | | | | | |
| Trochus niloticus (Linnaeus) | O | | | A | | | | |
| Tectus pyramis (Born) | | | | O | | | | |
| Littorina scabra (Linnaeus) | | | A | | | | | |
| Dendronoma maxima Sowerby | | | | | | O | | |

| | 4 | 4A | 4B | 5 | 5A | 5B | 18B | 18C |
|---|---|---|---|---|---|---|---|---|
| Cerithium coralium Kiener | | | A | | | | | |
| Cerithium zonatum (Wood) | | | | | R | | | |
| Strombus gibberulus gibbosus (Roeding) | | | | | O | | | |
| Strombus luhuanus (Linnaeus) | | | * | | | | | |
| Strombus mutablis (Swainson) | | | | | R | | | |
| Lambis lambis (Linnaeus) | | R | | | R | R | | |
| Lambis truncata sebae (Kiener) | | R | | | | | | |
| Cypraea annulus (Linnaeus) | | | | | A | | | |
| Cypraea moneta (Linnaeus) | | | | | A | O | | |
| Cypraea tigris (Linnaeus) | | | | | R | | | |
| Charonia tritonis (Linnaeus) | | | | O | | | | |
| Pyrene varians (Sowerby) | | | * | | A | | | |
| Conus miliaris (Hwass) | | | | | R | | | |
| Phyllidia sp. | | | | R | | | | |
| Arca ventricosa (Lamarck) | | | | | | | R | O |
| Pinctada margaritifera (Linnaeus) | | R | | | | | | |
| Malleus regula (Forskal) | | | | | | | | A |
| Pedum spondyloideum (Gmelin) | | | | | | O | A | A |
| Spondylus cf. squamosus (Schreibers) | | | | | | | | A |
| Lopha cristagalli (Linnaeus) | | | | | | | | O |
| Tridacna maxima (Roeding) | R | | | O | | | R | |
| Tridacna squamosa (Lamarck) | R | | | | | | | |
| Hippopus hippopus (Linnaeus) | | R | | | | | R | |
| Gafrarium pectinatum | | | | | * | | | |
| ARTHROPODA | | | | | | | | |
| Dardanus megistos (Herbst) | | | | R | | R | | |
| Grapsus sp. | | | O | | | | | |

(--Echinodermata, Chordata continued on next page)

(Conspicuous benthic invertebrates observed in the Map sector.
--continued from previous page.)

| | 4 | 4A | 4B | 5 | 5A | 5B | 18B | 18C |
|---|---|---|---|---|---|---|---|---|
| ECHINODERMATA | | | | | | | | |
| Ophiocoma sp. | | | | | A | | | |
| Ophiomastix cf. annulosa (Lamarck) | | | | A | | | | |
| Culcita novaeguineae (Muller & Troschel) | | | | | | O | | O |
| Fromia sp. | | | | | | | R | |
| Linckia laevigata (Linnaeus) | | | | | | R | | |
| Linckia multifora (Lamarck) | O | | | C | | | | |
| Protoreaster nodosus (Linnaeus) | | | | | | | | R |
| Acanthaster planci (Linnaeus) | | | | O | | | | |
| Echinaster leuzonicus (Gray) | | | | | | O | | |
| Echinometra mathaei (de Blainville) | C | | | | | | | A |
| Echinostrephus cf. aciculatus (A. Agassiz) | | A | | | O | | | |
| Heterocentrotus mammillatus (Linnaeus) | O | | | | | | | |
| Actinopyga miliaris (Quoy & Gaimard) | | | | | | | | O |
| Actinopyga sp. | | | | | | | | A |
| Bohadschia argus (Jaeger) | | R | | | | | | |
| Holothuria atra (Jaeger) | | | R | | C | O | | |
| Holothuria edulis (Lesson) | | | | | | O | R | O |
| Holothuria flavomaculata (Semper) | | | | | | | | R |
| Holothuria scabra (Jaeger) | | | O | | | | | |
| Stichopus chloronotus (Brandt) | | | | | | C | | |
| CHORDATA | | | | | | | | |
| Didemnum molle (Herdman) | | A | | | A | A | A | C |
| Eudistoma cf. viride (Tokioka) | | | | | | | O | |

Appendix C:

Conspicuous benthic invertebrates observed in the Rull sector.

| | 11A | 12 | 12A | 12B |
|---|---|---|---|---|
| PORIFERA | | | | |
| cf. Cinachyra sp. | C | | O | R |
| testillid sp. 1 | A | | O | R |
| branching sponge, orange | C | | | |
| finger sponge, black | | | | O |
| finger sponge, brown | | | R | |
| finger sponge, gray | A | | | |
| encrusting sponge, brown | A | | O | |
| black sponge | A | R | O | O |
| gray sponge | | | O | |
| Stylotella agminata | A | | O | O |
| red sponge | | R | | |
| CNIDARIA | | | | |
| Cassiopea medusa (Light) | | | | C |
| Clavularia sp. | | R | | |
| Lobophytum spp. | O | R | A | O |
| Sarcophyton sp. | O | R | | |
| Sinularia spp. | A | | A | A |
| Cirripathes sp. | C | | A | |
| ANNELIDA | | | | |
| Sabellastarte sanctijosephi (Gravier) | O | | C | O |

| | 11A | 12 | 12A | 12B |
|---|---|---|---|---|
| MOLLUSCA | | | | |
| Trochus niloticus (Linnaeus) | | R | | |
| Dendropoma maxima (Sowerby) | C | | C | A |
| Lambis lambis (Linnaeus) | R | | | O |
| Cypraea tigris (Linnaeus) | | | R | |
| Chelidonura amoena | | | O | |
| Pedum spondyloideum (Gmelin) | O | | | |
| Hyotissa hyotis (Linnaeus) | | | C | |
| Lopha cristagalli (Linnaeus) | R | | R | |
| Tridacna maxima (Roeding) | | | | R |
| Hippopus hippopus (Linnaeus) | R | | | |
| Octopus sp. | | | | O |
| ECHINODERMATA | | | | |
| Culcita novaeguineae (Muller & Troschel) | R | | | |
| Linckia multifora (Lamarck) | O | | | R |
| Acanthaster planci (Linnaeus) | O | | | |
| Echinaster callosus (von Marenzeller) | R | | | |
| Bohadschia argus (Jaeger) | O | | | R |
| Bohadschia graeffei (Semper) | R | | | |
| Holothuria edulis (Lesson) | | | O | |
| Stichopus variegatus (Semper) | | R | | |
| Thelenota ananas (Jaeger) | | R | | |
| CHORDATA | | | | |
| Didemnum molle (Herdman) | O | | | |
| Symplegma sp. | | | A | |

Appendix C:

Conspicuous benthic invertebrates observed in the Rumung sector.

| | 1 | 1A | 1B | 2 | 2A | 2B | 3 | 3A | 4A |
|---|---|---|---|---|---|---|---|---|---|
| **PORIFERA** | | | | | | | | | |
| cf. Cinachyra sp. | | | | | | | | | O |
| testillid sp. 1 | | | | | | | | | R |
| encrusting sponge, brown | | | | | | | | O | |
| black sponge | | R | | | O | R | | | R |
| brown sponge | | R | | | | O | | | |
| Stylotella agminata | | | O | | C | O | | O | A |
| **CNIDARIA** | | | | | | | | | |
| Cassiopea medusa Light | | | | | | | | R | |
| Clavularia sp. | A | | O | | | | A | | C |
| Cladiella sp. | | O | | | | | | | |
| Lobophytum spp. | | D | | | | | | | R |
| Sarcophyton sp. | O | | O | O | | | | | |
| Sinularia spp. | A | D | | A | | | | | A |
| Stereonephthya spp. | | | | | | | | | R |
| Anthelia sp. | | | | | | | | | C |
| Xenia sp. | A | O | | C | | | O | | O |
| Sympodium sp. (yellow) | | R | | | | | | | |
| Heteractis crispa (Ehrenberg) | | | | | | | | O | |
| Heteractis magnifica (Quoy & Gaimard) | | | | O | | | | | |
| Palythoa sp. | O | | | O | | | O | | |
| **ANNELIDA** | | | | | | | | | |
| Sabellastarte sanctijosephi (Gravier) | | | O | | | | | R | O |
| Spirobranchus giganteus (Pallas) | C | | C | C | O | | | | |
| **MOLLUSCA** | | | | | | | | | |
| Trochus maculatus (Linnaeus) | | | | | | | | | R |
| Trochus niloticus (Linnaeus) | O | | | O | | | C | | |
| Turbo argyrostomus(Linnaeus) | | | | | | | O | | |
| Littorina scabra (Linnaeus) | | | | | | C | | | |
| Dendropoma maxima(Sowerby) | | A | C | | C | | | O | C |
| Rhinoclavis fasciata (Bruguiere) | | | | | | | | C | |
| Rhinoclavis vertagus (Linnaeus) | | | | | | | | A | |

| | 1 | 1A | 1B | 2 | 2A | 2B | 3 | 3A | 4A |
|---|---|---|---|---|---|---|---|---|---|
| Strombus gibberulus gibbosus (Roeding) | | | | | | R | | A | |
| Lambis lambis (Linnaeus) | | R | | | | | | | R |
| Lambis truncata sebae (Kiener) | | | | | | | | | R |
| Cypraea tigris (Linnaeus) | | | | R | | | | O | |
| Polinices tumidus (Swainson) | | | | | | | | R | |
| Drupella elata (Blainville) | | | | O | | | | | |
| Mitrella ligula (Duclos) | | | | | | | | A | |
| Conus eburneus (Hwass) | | | | | | | | O | |
| Terebra affinis (Gray) | | | | | | | | O | |
| Terebra maculata (Linnaeus) | | | | | | | | O | |
| Phyllidia sp. | | | | O | | | | | |
| Arca ventricosa (Lamarck) | | | O | | | | | | O |
| Pinctada margaritifera (Linnaeus) | | | | | R | | | | R |
| Pedum spondyloideum (Gmelin) | | | R | | | | | | |
| Tridacna maxima (Roeding) | O | | | O | | | O | R | |
| Tridacna squamosa Lamarck | R | | R | | | | | | |
| Hippopus hippopus (Linnaeus) | | | R | | R | | | | |
| **ARTHROPODA** | | | | | | | | | |
| Grapsus sp. | | | | | | A | | | |
| **ECHINODERMATA** | | | | | | | | | |
| Culcita novaeguineae (Muller & Troschel) | R | C | | | | | | | |
| Fromia sp. | R | | | | | | | | R |
| Linckia guildingi Gray | | | | R | | | | | |
| Linckia multifora (Lamarck) | O | | | O | R | | | | |
| Acanthaster planci (Linnaeus) | | | | O | | | | | |
| Echinostrephus cf. aciculatus (A. Agassiz) | | R | | | | | | C | |
| Heterocentrotus mammillatus (Linnaeus) | R | | | | | | | | |
| Bohadschia argus (Jaeger) | | | | | | | | | R |
| Bohadschia graeffei(Semper) | | | | | | | | R | |
| Thelenota ananas (Jaeger) | | | R | | | | | | |
| Synapta maculata (Chamisso & Eysenhardt) | | | | | | | | O | |
| **CHORDATA** | | | | | | | | | |
| Didemnum molle (Herdman) | O | | | C | C | | | O | A |

Appendix D

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STONY CORALS | | | | | | | | | | | | | |
| PHYLUM CNIDARIA | | | | | | | | | | | | | |
| Fam. Acroporidae | | | | | | | | | | | | | |
| Acropora (I) cuneata | | | | | | C | | | A | | A | | |
| Acropora (I) palifera | D | C | A | | | | | | A | | C | A | |
| Acropora acuminata | A | | R | | | R | A | | | | | | |
| Acropora aspera | O | | | | | | | | | | C | | |
| Acropora austera | | | | | | | | | | | | | |
| Acropora cerealis | | | | | | | | | | | | | |
| Acropora cytherea | | A | A | | O | A | R | | | | | | |
| Acropora danai | | | | | | | | | | | | | |
| Acropora digitifera | O | | | O | | | | | | | | | |
| Acropora divaricata | | | | | C | | | | | | | | |
| Acropora echinata | | | | | | | A | | | | | C | |
| Acropora florida | | O | | | | | | | | | | | |
| Acropora formosa | A | C | C | O | | C | | | | | O | | |
| Acropora glauca | | | | | | | | | | | | | |
| Acropora grandis | | C | | | | | | | | | | | |
| Acropora hebes | | | | | | | | | | | | | |
| Acropora horrida | | | | | | | | | | | | | |
| Acropora humilis | C | C | C | | | C | | | A | | A | | |
| Acropora hyacinthus | | A | | | R | A | | | A | | A | | |
| Acropora irregularis | | A | O | | | A | | | A | | A | | |
| Acropora monticulosa | | | | | | | | | | | | | |
| Acropora nana | | | | | | | | | | | | | |
| Acropora nasuta | | | R | | | | | | | | R | | |
| Acropora nobilis | | | | | | | | | | | | | |
| Acropora palmerae | | | | | | | | | C | | | | |
| Acropora paniculata | | | | | | | | | | | | | |
| Acropora polymorpha* | | | | | | | | | | | | | |
| Acropora robusta* | | | | | | | | | | | | | |
| Acropora sp. cf secunda* | | | | | | | | | | | | | |
| Acropora sp. (blue)* | | | | | | | | | | | | | |
| Acropora surculosa | R | O | C | | | C | | | A | | C | | |
| Acropora teres | O | | | | | | | | | | | | |
| Acropora valida | | | C | | O | | | | O | | O | R | |
| Acropora vaughani | | | | | | | | | C | | C | | |
| Astreopora myriophthalma | R | | | | | | | | O | | | | |

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Astreopora sp. | | | | | | | | | | | | | |
| Montipora acanthella* | | | | | | | | | | | | | |
| Montipora aequituberculata | | | C | | | | | | | | | | |
| Montipora berryi* | | | | | | | | | | | | | |
| Montipora caliculata | | | | | | | | | | | | | |
| Montipora carinata* | | | | | | | | | | | | | |
| Montipora circumuallata* | | | | | | | | | | | | | |
| Montipora danae | | | | | | | | | | | | | |
| Montipora digitata | | | | | | | | | | | | | |
| Montipora ehrenbergii* | | | | | | | | | | | | | |
| Montipora foliosa | | | | | | | | | | | | | |
| Montipora foveolata | | | | | | | | | O | | C | | |
| Montipora hispida | | | | | | | | | R | | | | |
| Montipora hoffmeisteri | | | | C | | | | | | | | R | |
| Montipora informis | | | C | | | | | | | | | | |
| Montipora sp. cf intricata* | | | | | | | | | | | | | |
| Montipora lobulata | | | | | | | | | | | | | |
| Montipora monasteriata | | | | | | | | | | | | | |
| Montipora nodosa* | | | | | | | | | | | | | |
| Montipora spumosa* | | | | | | | | | | | | | |
| Montipora tuberculosa | | C | C | | | | O | | A | | C | | |
| Montipora turgescens | | | | | | | | | | | | | |
| Montipora undata* | | | | | | | | | | | | | |
| Montipora verrucosa | | | | | R | | | | | | | | |
| Fam. Agariciidae | | | | | | | | | | | | | |
| Gardineroseris planulata | | R | | | | | | | | | | | |
| Leptoseris columna | | | | | | | | | | | | | |
| Leptoseris incrustans | | | | | | | | | | | | | |
| Leptoseris mycetoseroides | | | | | | | | | | | | | |
| Leptoseris scabra | | | | | | | | | | | | | |
| Leptoseris yabai | | | | | | | | | | | | | |
| Leptoseris sp. | | | | | | | | | | | | | |
| Pachyseris rugosa | | | | | C | O | C | | | C | | C | |
| Pachyseris speciosa | | | | | | | | | | | | | |
| Pavona cactus | | | | | C | | | | | | | O | |
| Pavona clavus | | | | | | | | | | | | | |
| Pavona decussata | | | | | | | | | | | | | |
| Pavona divaricata | | | | C | | | | | | | | | |
| Pavona explanulata | | | R | | C | | | | | | | | |
| Pavona frondifera | | | | | | | | | | | | | |
| Pavona maldivensis | | | | | | | | | | | | | |
| Pavona varians | O | O | O | | C | | C | | | O | | C | |
| Pavona venosa | O | | | | | | | | | | | C | |
| Pavona sp. (explanate) | | | | | | | | | | | | | |

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Astrocoeniidae | | | | | | | | | | | | | |
| Stylocoeniella armata | | | C | | | O | | | | | | | |
| Fam. Caryophylliidae | | | | | | | | | | | | | |
| Euphyllia glabrescens | | | | | | | | | | R | | | |
| Euphyllia sp. | | | | | | | | | | | | | |
| Physogyra lichtensteini | | | | | O | | R | | | | | O | |
| Fam. Dendrophylliidae | | | | | | | | | | | | | |
| Tubastraea micrantha* | | | | | | | | | | | | | |
| Tubastraea coccinea | | | | | | | | | | | | | |
| Turbinaria stellulata | | | | | | | | | | | | | |
| Fam. Faviidae | | | | | | | | | | | | | |
| Barabattoia mirabilis | | | R | | | | | | | | | | |
| Caulastrea furcata | | | | | | | | | | | | | |
| Cyphastrea chalcidium | R | | R | | | | | | | | O | | |
| Cyphastrea microphthalma | | | | | C | | | | R | R | | | |
| Cyphastrea serailea | | | | | | | | | | | | | |
| Cyphastrea sp. | | | | | | | | | | | | | |
| Diploastrea heliopora | | C | C | | O | C | O | | | | C | | |
| Echinopora lamellosa | C | | C | | | C | C | | | | O | C | |
| Echinopora sp. cf E. horrida | | | | | | | | | | | | | |
| Favia danae | | | | | | | | | | | | | |
| Favia favus | | | C | | | R | | | | | O | | |
| Favia laxa | | R | O | | | | O | | O | | O | | |
| Favia matthaii | | | | | | | | | | | R | | |
| Favia pallida | O | O | R | C | O | O | | | R | C | O | O | |
| Favia rotumana | | | | | | | | | | | | | |
| Favia sp. rotundata | | | | | | O | | | | | | | |
| Favia speciosa | | | | | | | | | | | O | | |
| Favia stelligera | | C | C | C | | C | | | C | | | O | |
| Favites abdita | | | O | | | C | | | C | | O | | |
| Favites chinensis | | | | | | | | | | | | | |
| Favites sp. cf F. complanata* | | | | | | | | | | | | | |
| Favites flexuosa | O | O | | O | | C | | | | | O | | |
| Favites pentagona | | | | | | | | | | | | | |
| Favites sp. | | | | | | | | | | | | R | |
| Goniastrea edwardsi | | | | | | | | | | | | | |
| Goniastrea palauensis | | | | | | | | | R | | | | |
| Goniastrea pectinata | O | | | | C | | C | | | | | O | |
| Goniastrea retiformis | O | | C | | | C | O | | C | C | C | | |
| Hydnophora exesa | | | | | | | | | | | | | |
| Hydnophora microconos | O | | C | | | C | | | C | | O | | |
| Hydnophora rigida | O | | O | | C | O | R | | | | | O | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leptastrea bottae | | | | | | | | | | | | | |
| Leptastrea purpurea | | | | | | O | R | | | | | | |
| Leptastrea transversa | | | | | | | R | | C | | | | |
| Leptoria phrygia | O | | A | | O | A | O | | A | | C | | |
| Montastrea sp.* | | | O | | | | | | O | | | | |
| Oulophyllia crispa | R | | O | | O | O | | | | | R | R | |
| Platygyra daedalea | | C | A | | | A | O | | C | | C | | |
| Platygyra lamellina | | O | | | | | | | | | R | | |
| Platygyra pini | | | | | | | | | | | | | |
| Plesiastrea versipora | | O | | | | | | | | | | | |
| Fam. Fungiidae | | | | | | | | | | | | | |
| Cycloseris costulata | | | | | | | | | | | | | |
| Fungia (C) echinata | | | | C | C/A | | | | | O | | O | |
| Fungia (D) concinna | | | | C | C | | O | | | | | O | |
| Fungia (D) danai | R | | | | | | | | | | | | |
| Fungia (P) paumotensis | | | R | | R | | R | | | | | | |
| Fungia (P) scutaria | O | O | O | | | O | | | | | | | |
| Fungia fungites | | | | C | | | O | | | | | | |
| Halomitra pileus | | | | | | | | | | | | | |
| Heliofungia actiniformis | | | | R | R | | R | | | R | | R | |
| Herpolitha limax | | | | | R | | | | | | | | |
| Polyphyllia talpina | | | | | O | | | | | | | | |
| Sandalolitha robusta | | | | | O | | | | | | | | |
| Fam. Helioporidae | | | | | | | | | | | | | |
| Heliopora coerulea | | R | | | | | R | | | | | | |
| Fam. Merulinidae | | | | | | | | | | | | | |
| ?Clavarina triangularis | | | | | | | | | | | | | |
| Merulina ampliata | C | | | | C | | R | | | | | R | |
| Merulina sp. | | | | | | | | | | | | | |
| Scapophyllia cylindrica | | | | | | | | | | | | | |
| Fam. Milleporidae | | | | | | | | | | | | | |
| Millepora dichotoma | | | | O | A | | | | | | | O | |
| Millepora intricata* | | | | | | | | | | | | | |
| Millepora platyphylla | | | C | | | C | | | | | C | | |
| Millepora exaesa | C | | | | O | | C | | | | | C | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | | | | | | |
| Lobophyllia corymbosa | R | | O | O | R | | | | | | | | |
| Lobophyllia hataii | | | | R | | | O | | | | | | |
| Lobophyllia hemprichii | | C | C | | | C | | | | | | | |
| Scolymia sp. cf S. vitiensis | | | | | | | | | | | | | |
| Symphyllia recta | | O | O | | | | | | | | | | |
| Symphyllia sp. | | | | | | | | | | | | | |
| Symphyllia valenciennesii | R | R | R | O | | | | | | | | R | |
| Fam. Oculinidae | | | | | | | | | | | | | |
| Acrhelia horrescens | | | | C | C | | O | | | O | | O | |
| Galaxea fascicularis | | | C | | R | C | | | O | | C | | |
| Galaxea sp. (explanate) | | | | | | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | | | | | | |
| Echinophyllia aspera | | O | O | | O | | | | | | | | |
| Mycedium elephantotus | R | | | | O | | | | | | | | |
| Oxypora lacera | | | O | | | | | | | | | | |
| Pectinia lactuca | | | | | | | | | | | | C | |
| Pectinia paeonia | | | | | C | | | | | | | | |
| Fam. Pocilloporidae | | | | | | | | | | | | | |
| Pocillopora damicornis | | | | C | | | O | | | | | | |
| Pocillopora elegans | | | R | | | | | | | | | | |
| Pocillopora eydouxi | | | | | | | | | C | | | | |
| Pocillopora ligulata* | | | | | | | | | | | | | |
| Pocillopora meandrina | | | O | | | | | | | | O | | |
| Pocillopora sp. (bottlebrush)* | | | | | | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | | | | | | |
| Pocillopora verrucosa | C | C | C | | | C | | | | | O | | |
| Seriatopora hystrix | O | | | ? | C | | C | | | C | | | |
| Stylophora pistillata | C | | | C | | C | O | | | O | O | O | |
| Fam. Poritidae | | | | | | | | | | | | | |
| Alveopora allingi | | | | | | | | | | | | | |
| Goniopora arbuscula* | | | | | | | | | | | | | |
| Goniopora columna | | | D | | | | | | | | | | |
| Goniopora fruticosa | | | | | C | | | | | | | O | |
| Goniopora lobata | | | | | O | R | R | | | C | | | |
| Goniopora spp. | | O | | | | | | | | | | | |
| Porites (N) vaughani | | | | | | | | | | | | | |
| Porites (S) rus | | | | | A | | C | | | A | | C | |
| Porites australiensis | | | O | | | O | C | | | | | | |
| Porites cocosensis* | | | | | | | | | | | | | |
| Porites cylindrica | | | | C | D | | A | | | D | | A | |

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | | | | | | |
| Lobophyllia corymbosa | R | | O | O | R | | | | | | | | |
| Lobophyllia hataii | | | | R | | | O | | | | | | |
| Lobophyllia hemprichii | | C | C | | | C | | | | | | | |
| Scolymia sp. cf S. vitiensis | | | | | | | | | | | | | |
| Symphyllia recta | | O | O | | | | | | | | | | |
| Symphyllia sp. | | | | | | | | | | | | | |
| Symphyllia valenciennesii | R | R | R | O | | | | | | | | R | |
| Fam. Oculinidae | | | | | | | | | | | | | |
| Acrhelia horrescens | | | | C | C | | O | | | O | | O | |
| Galaxea fascicularis | | | C | | R | C | | | O | | C | | |
| Galaxea sp. (explanate) | | | | | | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | | | | | | |
| Echinophyllia aspera | | O | O | | O | | | | | | | | |
| Mycedium elephantotus | R | | | | O | | | | | | | | |
| Oxypora lacera | | | O | | | | | | | | | | |
| Pectinia lactuca | | | | | | | | | | | | C | |
| Pectinia paeonia | | | | | C | | | | | | | | |
| Fam. Pocilloporidae | | | | | | | | | | | | | |
| Pocillopora damicornis | | | | C | | | O | | | | | | |
| Pocillopora elegans | | | R | | | | | | | | | | |
| Pocillopora eydouxi | | | | | | | | | C | | | | |
| Pocillopora ligulata* | | | | | | | | | | | | | |
| Pocillopora meandrina | | | O | | | | | | | | O | | |
| Pocillopora sp. (bottlebrush)* | | | | | | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | | | | | | |
| Pocillopora verrucosa | C | C | C | | | C | | | | | O | | |
| Seriatopora hystrix | O | | | ? | C | | C | | | C | | | |
| Stylophora pistillata | C | | | C | | C | O | | | O | O | O | |
| Fam. Poritidae | | | | | | | | | | | | | |
| Alveopora allingi | | | | | | | | | | | | | |
| Goniopora arbuscula* | | | | | | | | | | | | | |
| Goniopora columna | | | D | | | | | | | | | | |
| Goniopora fruticosa | | | | | C | | | | | | | O | |
| Goniopora lobata | | | | | O | R | R | | | C | | | |
| Goniopora spp. | | O | | | | | | | | | | | |
| Porites (N) vaughani | | | | | | | | | | | | | |
| Porites (S) rus | | | | | A | | C | | | A | | C | |
| Porites australiensis | | | O | | | O | C | | | | | | |
| Porites cocosensis* | | | | | | | | | | | | | |
| Porites cylindrica | | | | C | D | | A | | | D | | A | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 1

| STATION No. | 18d | 18 | 1 | 1a | 1b | 2 | 2a | 2b | 3 | 3a | 4 | 4a | 4b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Porites horizontalata* | | | | | | | | | | | | | |
| Porites lichen | | | | O | O | | A | | | C | | C | |
| Porites lobata | | | C | | C | C | | | | C | C | | |
| Porites lutea | | | | | | | | | | | | A | |
| Porites murrayensis | | | | | | | | | | | | | |
| Porites nigrescens | | | | R | | | | | | | | | |
| Porites sp. cf P. crassatellata* | | | | | | | | | | | | | |
| Porites sp. cf P. tenuis* | | | | | | | | | | | | | |
| Porites solida | | O | O | | | | | | | | | | |
| Porites superfusa | O | | | | | | | | | | | | |
| Fam. Rhizangiidae | | | | | | | | | | | | | |
| Culicia rubeola* | | | | | | | | | | | | | |
| Fam. Siderastreidae | | | | | | | | | | | | | |
| Coscinaraea columna | | R | O | | | | | | | | | | |
| Coscinaraea wellsi | | | | | | | | | | | | | |
| Fam. Stylasteridae | | | | | | | | | | | | | |
| Distichopora gracilis | | | | | | | | | | | | | |
| Fam. Thamnasteriidae | | | | | | | | | | | | | |
| Psammocora contigua | | | | | | | | | | | | | |
| Psammocora digitata | | | | | | | R | | | | | | |
| Psammocora haimeana | | | | | | O | | | | | | | |
| Psammocora profundacella | | | | | | | | | | | R | | |
| Psammocora stellata | | | | | | | | | | | | | |
| Psammocora superficialis | | | | | | | | | | | | | |
| Fam. Tubiporidae | | | | | | | | | | | | | |
| Tubipora musica | | O | | | O | C | | | C | | O | | |
| Order Antipatharia (black corals) | | | | | | | | | | | | | |
| Cirrhipathes sp. | | | | | | | | | | | | | |

* = Species reported only prior to 1987 surveys

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 | | | | | SECTION 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5a | 5b | 5 | 6 | 6a | 7a | 7b | 7 | 8a | 8b | 8 |
| STONY CORALS | | | | | | | | | | | |
| PHYLUM CNIDARIA | | | | | | | | | | | |
| Fam. Acroporidae | | | | | | | | | | | |
| Acropora (I) cuneata | | | C | | | | | | | | |
| Acropora (I) palifera | | | C | C | | | | A | | | A |
| Acropora acuminata | | A/D | | | | | | O | | | R |
| Acropora aspera | | | | | | | | | | | |
| Acropora austera | | | | | | | | | | | |
| Acropora cerealis | | | | | | | | | | | |
| Acropora cytherea | | | | | | | R | O | | | O |
| Acropora danai | | | | | | | | O | | | |
| Acropora digitifera | | | | | | | O | | | | O |
| Acropora divaricata | | | | | | | | | | | |
| Acropora echinata | | A | | | | | | | | | |
| Acropora florida | | | | C | | | | O | | | |
| Acropora formosa | | C | C | | | | C | C | | | O |
| Acropora glauca | | | O | | | | | | | | |
| Acropora grandis | | | | | | | | | | | |
| Acropora hebes | | | | | | | | | | | |
| Acropora horrida | | | | | | | | | | | |
| Acropora humilis | | | | | | | | C | | | O |
| Acropora hyacinthus | | | A | | | | | C | | | C |
| Acropora irregularis | | | A | C | | | | | | | A |
| Acropora monticulosa | | | | | | | | | | | |
| Acropora nana | | | | | | | | | | | |
| Acropora nasuta | | | | | | | | | | | |
| Acropora nobilis | | | | | | | | | | | |
| Acropora palmerae | | | | | | | | | | | |
| Acropora paniculata | | | | | | | | | | | |
| Acropora polymorpha* | | | | | | | | | | | |
| Acropora robusta* | | | | | | | | | | | |
| Acropora sp. cf secunda* | | | | | | | | | | | |
| Acropora sp. (blue)* | | | | | | | | | | | |
| Acropora surculosa | | | | | | | | O | | | C |
| Acropora teres | | | | | | | | | | | |
| Acropora valida | | | | | | | | | | | O |
| Acropora vaughani | | | | | | | | R | | | O |
| Astreopora myriophthalma | | | | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Astreopora sp. | | | | | | | | | | | |
| Montipora acanthella* | | | | | | | | | | | |
| Montipora aequituberculata | | | | | | | | | | | |
| Montipora berryi* | | | | | | | | | | | |
| Montipora caliculata | | | C | | C/A | | | | | | |
| Montipora carinata* | | | | | | | | | | | |
| Montipora circumuallata* | | | | | | | | | | | |
| Montipora danae | | | | | | | | | | | |
| Montipora digitata | | | | | | | | | | | |
| Montipora ehrenbergii* | | | | | | | | | | | |
| Montipora foliosa | | | | | | | | | | | |
| Montipora foveolata | | | | O | | | | | | | |
| Montipora hispida | | | | | | | | | | | |
| Montipora hoffmeisteri | | | | | | | | | | | |
| Montipora informis | | | | C | O | | | | | | |
| Montipora sp. cf intricata* | | | | | | | | | | | |
| Montipora lobulata | | C | | | | | | | | | |
| Montipora monasteriata | | | | | | | | | | | |
| Montipora nodosa* | | | | | | | | | | | |
| Montipora spumosa* | | | | | | | | | | | |
| Montipora tuberculosa | | D | | O | | | | | | | |
| Montipora turgescens | | | | | | | | | | | |
| Montipora undata* | | | | | | | | | | | |
| Montipora verrucosa | | | | | | | | | | | |
| Fam. Agariciidae | | | | | | | | | | | |
| Gardineroseris planulata | | | | | | | | | | | |
| Leptoseris columna | | | | | | | | | | | |
| Leptoseris incrustans | | | | | | | | | | | |
| Leptoseris mycetoseroides | | | | | | | | | | | |
| Leptoseris scabra | | | | | | | | | | | |
| Leptoseris yabai | | | | | | | | | | | |
| Leptoseris sp. | | | | | | | | | | | |
| Pachyseris rugosa | | | | | | C | | | | | |
| Pachyseris speciosa | | | | | | | | | | | |
| Pavona cactus | | | | | | | C | | | A | |
| Pavona clavus | | | | | | | | | | | |
| Pavona decussata | | | | | | | | | | | |
| Pavona divaricata | | | | | | | | | | | |
| Pavona explanulata | | | | | | | | | | | |
| Pavona frondifera | | | | | | | | | | | |
| Pavona maldivensis | | | | | | | | | | | |
| Pavona varians | | | | | | O | | | | | |
| Pavona venosa | | O | | | O | | | | | | |
| Pavona sp. (explanate) | | | | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Astrocoeniidae | | | | | | | | | | | |
| Stylocoeniella armata | | O | | R | | | | O | | | C |
| Fam. Caryophylliidae | | | | | | | | | | | |
| Euphyllia glabrescens | | | | | | | | | | | |
| Euphyllia sp. | | | | | | | | | | | |
| Physogyra lichtensteini | | D | | | | O | | | | O | |
| Fam. Dendrophylliidae | | | | | | | | | | | |
| Tubastraea micrantha* | | | | | | | | | | | |
| Tubastraea coccinea | | | | | | | | | | | |
| Turbinaria stellulata | | | | | | | | R | | | |
| Fam. Faviidae | | | | | | | | | | | |
| Barabattoia mirabilis | | | | | | | | | | | |
| Caulastrea furcata | | | | | | | | | | | |
| Cyphastrea chalcidium | | | | O | | | | O | | | R |
| Cyphastrea microphthalma | | | C | | | | | R | | O | C |
| Cyphastrea serailea | | | | | | | | | | | |
| Cyphastrea sp. | | | | | | | | | | | |
| Diploastrea heliopora | | | | C | | | | O | | | |
| Echinopora lamellosa | | C | O | R | | O | | O | | | |
| Echinopora sp. cf E. horrida | | | | | | | | | | | |
| Favia danae | | | | | | | | | | | |
| Favia favus | | | | R | | | | | | | |
| Favia laxa | | | | O | | | | | | | |
| Favia matthaii | | | | | | | | | | | |
| Favia pallida | | C | C | O | C | | O | O | | C | |
| Favia rotumana | | | | | | | | | | | |
| Favia sp. rotundata | | | | | | | | O | | | |
| Favia speciosa | | | | | | | | | | | |
| Favia stelligera | | O | C | C | | | | | | | |
| Favites abdita | | C | | O | O | | | | | | |
| Favites chinensis | | | | | | | | | | | |
| Favites sp. cf F. complanata* | | | | | | | | | | | |
| Favites flexuosa | | C | | | O | | | O | | | |
| Favites pentagona | | | | | | | | | | | |
| Favites sp. | | | | | | | | | | | |
| Goniastrea edwardsi | | | | | | | | | | | |
| Goniastrea palauensis | | | R | | | | | | | | |
| Goniastrea pectinata | | C | | | | R | | | | | |
| Goniastrea retiformis | | | | | O | | | | | O | |
| Hydnophora exesa | | | | | | | | R | | | |
| Hydnophora microconos | | | C | O | | | | | | | O |
| Hydnophora rigida | | O | | C | | | C | C | | C | O |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Leptastrea bottae | | | | | | | | | | | |
| Leptastrea purpurea | | | | | | | | | | | |
| Leptastrea transversa | | O | | | | | | | | | |
| Leptoria phrygia | | O | C | C | | | | A | | | A |
| Montastrea sp.* | | | O | | | | | | | | |
| Oulophyllia crispa | | | | | | | | O | | | |
| Platygyra daedalea | | | A | C | | | | O | | C | O |
| Platygyra lamellina | | O | | | | | | | | O | |
| Platygyra pini | | | | | | | | | | | |
| Plesiastrea versipora | | O | | | | | | | | | |
| Fam. Fungiidae | | | | | | | | | | | |
| Cycloseris costulata | | | | | | | | | | | |
| Fungia (C) echinata | | O | | | | | O | | | | |
| Fungia (D) concinna | | | | | | | R | | | | |
| Fungia (D) danai | | | | | | | | | | | |
| Fungia (P) paumotensis | | | | | | | | | | | |
| Fungia (P) scutaria | | | | | | | | | | | |
| Fungia fungites | | C | | | | | O | | | | |
| Halomitra pileus | | | | | | | | | | | |
| Heliofungia actiniformis | | | | | | | O | | | | |
| Herpolitha limax | | | R | | | | | | | | |
| Polyphyllia talpina | | | | | | | | | | | |
| Sandalolitha robusta | | | | | | | | | | | |
| Fam. Helioporidae | | | | | | | | | | | |
| Heliopora coerulea | | | R | O | | | | | | | |
| Fam. Merulinidae | | | | | | | | | | | |
| ?Clavarina triangularis | | | | | | | | | | | |
| Merulina ampliata | | O | | | | O | R | | | | |
| Merulina sp. | | | | | | | | | | | |
| Scapophyllia cylindrica | | | | | | | | | | | |
| Fam. Milleporidae | | | | | | | | | | | |
| Millepora dichotoma | | | | | | O | O | | | C | |
| Millepora intricata* | | | | | | | | | | | |
| Millepora platyphylla | | | | | | | | C | | | C |
| Millepora exaesa | | | | | | C | O | | | C | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | | | | |
| Lobophyllia corymbosa | | | O | | | R | | | | | |
| Lobophyllia hataii | | | | | | | | | | | |
| Lobophyllia hemprichii | | | | C | | | | | | | |
| Scolymia sp. cf S. vitiensis | | | | | | | | | | | |
| Symphyllia recta | | | R | | | | | O | | | |
| Symphyllia sp. | | | | | | | | | | | |
| Symphyllia valenciennesii | | | | | | | | | | | O |
| Fam. Oculinidae | | | | | | | | | | | |
| Acrhelia horrescens | | C | | | | | R | | | | |
| Galaxea fascicularis | | | C | O | | | | O | | | C |
| Galaxea sp. (explanate) | | | | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | | | | |
| Echinophyllia aspera | | | O | A/D | | R | | O | | | |
| Mycedium elephantotus | | O | | | | | | | | O | |
| Oxypora lacera | | | R | | | | | | | | |
| Pectinia lactuca | | | | | | | | | | O | |
| Pectinia paeonia | | | | | | | | | | | |
| Fam. Pocilloporidae | | | | | | | | | | | |
| Pocillopora damicornis | | O | | | O | C | O | | | C | |
| Pocillopora elegans | | | | | | | | | | | |
| Pocillopora eydouxi | | | | | | | | C | | | O |
| Pocillopora ligulata* | | | | | | | | | | | |
| Pocillopora meandrina | | | | | | | | | | | |
| Pocillopora sp. (bottlebrush)* | | | | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | | | | |
| Pocillopora verrucosa | | | C | O | | | | O | | | C |
| Seriatopora hystrix | | C | | | | C | C | | | C | |
| Stylophora pistillata | | C | C | O | | C | C | C | | C | C |
| Fam. Poritidae | | | | | | | | | | | |
| Alveopora allingi | | | | | | | | | | | |
| Goniopora arbuscula* | | | | | | | | | | | |
| Goniopora columna | | | R | | | | | | | | |
| Goniopora fruticosa | | | | | | O | | | | | |
| Goniopora lobata | | | | | | C | | | | | |
| Goniopora spp. | | | | | | | C | | | | |
| Porites (N) vaughani | | | | | | | | | | | |
| Porites (S) rus | | C | | A/D | | C | | | | C | |
| Porites australiensis | | C/A | | | | | O | | | C | |
| Porites cocosensis* | | | | | | | | | | | |
| Porites cylindrica | | A/D | | | C | A | A | | | D | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLAND SPECIES LIST

| STATION No. | SECTION 2 5a | 5b | 5 | 6 | 6a | SECTION 3 7a | 7b | 7 | 8a | 8b | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Porites horizontalata* | | | | | | | | | | | |
| Porites lichen | | C | | O | | | C | | | C | |
| Porites lobata | | | C/A | | | | | C | | | |
| Porites lutea | | | | | C | C | C | | | | |
| Porites murrayensis | | | | | O | | | | | | |
| Porites nigrescens | | | | | | | | | | | |
| Porites sp. cf P. crassatellata* | | | | | | | | | | | |
| Porites sp. cf P. tenuis* | | | | | | | | | | | |
| Porites solida | | | | | | | | | | | |
| Porites superfusa | | | | | | | | | | | |
| Fam. Rhizangiidae | | | | | | | | | | | |
| Culicia rubeola* | | | | | | | | | | | |
| Fam. Siderastreidae | | | | | | | | | | | |
| Coscinaraea columna | | | R | | | | | | | | |
| Coscinaraea wellsi | | | | | | | | | | | |
| Fam. Stylasteridae | | | | | | | | | | | |
| Distichopora gracilis | | | | | | | | | | | |
| Fam. Thamnasteriidae | | | | | | | | | | | |
| Psammocora contigua | | | | | C | | | | | | |
| Psammocora digitata | | | | | | O | | O | | O | |
| Psammocora haimeana | | | R | | | | | | | | |
| Psammocora profundacella | | | | | | | | | | | |
| Psammocora stellata | | | | | | | | | | | |
| Psammocora superficialis | | | | | | | | R | | | |
| Fam. Tubiporidae | | | | | | | | | | | |
| Tubipora musica | | | C | | | | | | | | |
| Order Antipatharia (black corals) | | | | | | | | | | | |
| Cirrhipathes sp. | | | | | | | | | | | |

* = Species reported only prior to 1987 surveys

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STONY CORALS | | | | | | | | | | | | | | | |
| PHYLUM CNIDARIA | | | | | | | | | | | | | | | |
| Fam. Acroporidae | | | | | | | | | | | | | | | |
| Acropora (I) cuneata | | | | A | A | | | | | | | | | | |
| Acropora (I) palifera | C | A | | O | O | | | | | | | | | | |
| Acropora acuminata | | | | | | | | | | | | | | | O |
| Acropora aspera | | | | | | | | | | | | | | | R |
| Acropora austera | | | | | | | | | | | | | | | |
| Acropora cerealis | | | | | | | | | | | | | | | |
| Acropora cytherea | | | | | | | | | | | | | | | |
| Acropora danai | | | | | | | | | | | | | | | |
| Acropora digitifera | C | C | | | | | | | | | | | | | |
| Acropora divaricata | | | | | | | | | | | | | | | |
| Acropora echinata | | | | | | | | | | | | | | | |
| Acropora florida | | | | C | O | | | | | | | | | | |
| Acropora formosa | O | | | C | C | | | | | | | | | | |
| Acropora glauca | | | | | | | | | | | | | | | |
| Acropora grandis | | | | | | | | | | | | | | | |
| Acropora hebes | | | | | | | | | | | | | | | |
| Acropora horrida | | | | | R | | | | | | | | | | |
| Acropora humilis | | | | | | | | | | | | | | | |
| Acropora hyacinthus | | O | | | O | | | | | | | | | | |
| Acropora irregularis | | | | C | O | | | | | | | | | | |
| Acropora monticulosa | | | | | | | | | | | | | | | |
| Acropora nana | | | | | | | | | | | | | | | |
| Acropora nasuta | | | | | | | | | | | | | | | |
| Acropora nobilis | | | | | | | | | | | | | | | |
| Acropora palmerae | | | | | | | | | | | | | | | |
| Acropora paniculata | | | | | | | | | | | | | | | |
| Acropora polymorpha* | | | | | | | | | | | | | | | |
| Acropora robusta* | | | | | | | | | | | | | | | |
| Acropora sp. cf secunda* | | | | | | | | | | | | | | | |
| Acropora sp. (blue)* | | | | | R | | | | | | | | | | |
| Acropora surculosa | | C | | | C | | | | | | | | | | |
| Acropora teres | | | | | | | | | | | | | | | |
| Acropora valida | | C | | O | O | | | | | | | | | | |
| Acropora vaughani | | | | | | | | | | | | | | | |
| Astreopora myriophthalma | | | | | | | R | C | R | | | | | | O |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Astreopora sp. | | | | | | | | | | | | | | | |
| Montipora acanthella* | | | | | | | | | | | | | | | |
| Montipora aequituberculata | | | | | | | | | | | | | | | |
| Montipora berryi* | | | | | | | | | | | | | | | |
| Montipora caliculata | | | | | | | | | | | | | R | | |
| Montipora carinata* | | | | | | | | | | | | | | | |
| Montipora circumuallata* | | | | | | | | | | | | | | | |
| Montipora danae | | | | | | | | | | | | | | | |
| Montipora digitata | | | | | | | | | | | | | | | C |
| Montipora ehrenbergii* | | | | | | | | | | | | | | | |
| Montipora foliosa | | | | | | | | | | | | | | | |
| Montipora foveolata | | C | | R | O | | O | | | | | | | | |
| Montipora hispida | | | | | | | | | | | | | | | |
| Montipora hoffmeisteri | | | | | | | | | O | | | | | | |
| Montipora informis | | | | | | | | C | | | | | | | |
| Montipora sp. cf intricata* | | | | | | | | | | | | | | | |
| Montipora lobulata | | | | | | | | | | | | | | | |
| Montipora monasteriata | | | | | | | | | | | | | | | |
| Montipora nodosa* | | | | | | | | | | | | | | | |
| Montipora spumosa* | | | | | | | | | | | | | | | |
| Montipora tuberculosa | | | | | | | | | | | | | | | |
| Montipora turgescens | | | | | | | | O | C | | | | | | C |
| Montipora undata* | | | | | | | | | | | | | | | |
| Montipora verrucosa | | | | | | | | | | | | | | | |
| Fam. Agariciidae | | | | | | | | | | | | | | | |
| Gardineroseris planulata | | | | | | | | | | | | | | | |
| Leptoseris columna | | | | | | | | | | | | | | | |
| Leptoseris incrustans | | | | | | | | | | | | | | | |
| Leptoseris mycetoseroides | | | | | | | | | | | | | | | |
| Leptoseris scabra | | | | | | A | A | | C | | | | | | O |
| Leptoseris yabai | | | | | | C | | | O | | | | | | |
| Leptoseris sp. | | | | | | | | | | | | | | | |
| Pachyseris rugosa | | | | O | C | | C | O | O | | | | | | |
| Pachyseris speciosa | | | | | | | A | | A | | | | | | D |
| Pavona cactus | | | | | | | | | | | | | | | |
| Pavona clavus | | | | | | | | | | | | | | | |
| Pavona decussata | | | | | | | | | | | | | | | |
| Pavona divaricata | | | | | | | | | | | | | | | |
| Pavona explanulata | | | | | | | | C | | | | | | | |
| Pavona frondifera | | | | | | | | | | | | | | | |
| Pavona maldivensis | | | | | | | | | | | | | | | |
| Pavona varians | | | | | | O | O | | O | | | | | | O |
| Pavona venosa | | | | | | | | | | | | | | | |
| Pavona sp. (explanate) | | | | | | | | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | SECTION 4 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Astrocoeniidae | | | | | | | | | | | | | | | |
| Stylocoeniella armata | | | | R | | | | | | | | | | | |
| Fam. Caryophylliidae | | | | | | | | | | | | | | | |
| Euphyllia glabrescens | | | | | | | | | | | | | | | |
| Euphyllia sp. | | | | | | | | | | | | | | | |
| Physogyra lichtensteini | | | | | | | | | | | | | | | R |
| Fam. Dendrophylliidae | | | | | | | | | | | | | | | |
| Tubastraea micrantha* | | | | | | | | | | | | | | | |
| Tubastraea coccinea | | | | | | | | | | | | | | | C |
| Turbinaria stellulata | | | | | O | | | | | | | | | | |
| Fam. Faviidae | | | | | | | | | | | | | | | |
| Barabattoia mirabilis | | | | | | | R | | C | | | | | | |
| Caulastrea furcata | | | | | | | | | | | | | | | |
| Cyphastrea chalcidium | | | | | | | | | | | | | | | |
| Cyphastrea microphthalma | | O | | O | O | | | | | | | | | | |
| Cyphastrea serailea | C | | | | | | | | | | | | | | |
| Cyphastrea sp. | | | | | | | | | | | | | | | |
| Diploastrea heliopora | | | | A | C | | | | | | | | | | |
| Echinopora lamellosa | | | | O | R | | | | | | | | | | |
| Echinopora sp. cf E. horrida | | | | | | | | | | | | | | | |
| Favia danae | | | | | | | | | | | | | | | |
| Favia favus | | | | | | R | | | | | | | | | |
| Favia laxa | | | | | | R | | | | | | | | | |
| Favia matthaii | | | | | | | | | | | | | | | |
| Favia pallida | C | | | R | R | A | C | C | C | | | | | | O |
| Favia rotumana | | | | | | | | | | | | | | | |
| Favia sp. rotundata | | | | R | | | | | | | | | | | |
| Favia speciosa | | | | | | | | | | | | | | | |
| Favia stelligera | | | | | | | | | | | | | | | |
| Favites abdita | O | O | | | | | | | C | | | | | | |
| Favites chinensis | | | | | | | | | | | | | | | |
| Favites sp. cf F. complanata* | | | | O | | | | | | | | | | | |
| Favites flexuosa | | | | O | R | | | | | | | | | | |
| Favites pentagona | | | | R | | | | O | | | | | | | |
| Favites sp. | | | | | | | | | | | | | | | |
| Goniastrea edwardsi | | | | | | O | O | | | | | | | | |
| Goniastrea palauensis | | | | | | | | | | | | | | | |
| Goniastrea pectinata | | | | O | | | | | | | | | | | |
| Goniastrea retiformis | | O | | | O | | | | | | | | | | |
| Hydnophora exesa | | | | | | | | | | | | | | | |
| Hydnophora microconos | C | C | | R | R | | | | | | | | | | |
| Hydnophora rigida | C | | | D | C | | C | | C | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | SECTION 4 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leptastrea bottae | | | | | | | | | | | | | | | |
| Leptastrea purpurea | | O | | | | | | | | | | | R | | O |
| Leptastrea transversa | | | | | | O | | | | | | | | | |
| Leptoria phrygia | | C | | A | A | | | | | | | | | | |
| Montastrea sp.* | | R | | | | | | | | | | | | | |
| Oulophyllia crispa | | | | R | | | | | | | | | | | |
| Platygyra daedalea | C | C | | O | R | | | | | | | | | | |
| Platygyra lamellina | O | O | | C | R | | | | | | | | | | |
| Platygyra pini | | | | | | | | O | | | | | | | |
| Plesiastrea versipora | | | | | | | | | | | | | | | |
| Fam. Fungiidae | | | | | | | | | | | | | | | |
| Cycloseris costulata | | | | | | | | | | | | | | | |
| Fungia (C) echinata | | | | | | | C | C | | | | | | | |
| Fungia (D) concinna | | | | | | | | | | | | | | | |
| Fungia (D) danai | | | | | | | | | | | | | | | |
| Fungia (P) paumotensis | | | | | | | | | | | | | | | |
| Fungia (P) scutaria | | | | R | | | | | | | | | | | |
| Fungia fungites | | | | | | | | | | | | | | | |
| Halomitra pileus | | | | | | | | | | | | | | | |
| Heliofungia actiniformis | | | | | | | | | | | | | | | |
| Herpolitha limax | | | | | | | | | | | | | | | |
| Polyphyllia talpina | | | | | | | | | | | | | | | |
| Sandalolitha robusta | | | | R | | | | | | | | | | | |
| Fam. Helioporidae | | | | | | | | | | | | | | | |
| Heliopora coerulea | | | | | | | | | | | | | | | |
| Fam. Merulinidae | | | | | | | | | | | | | | | |
| ?Clavarina triangularis | | | | | | | | | | | | | | | |
| Merulina ampliata | | | | | | | | | | | | | | | |
| Merulina sp. | | | | | | | | | | | | | | | |
| Scapophyllia cylindrica | | | | | | | | | | | | | | | |
| Fam. Milleporidae | | | | | | | | | | | | | | | |
| Millepora dichotoma | | | | | | | | | | | | | | | |
| Millepora intricata* | | | | | | | | | | | | | | | |
| Millepora platyphylla | | | | O | O | | | | | | | | | | |
| Millepora exaesa | | | | | R | O | | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | | | | | | | | |
| Lobophyllia corymbosa | | | | R | | | | | | | | | | | |
| Lobophyllia hataii | | | | | | O | | C | | | | | | | R |
| Lobophyllia hemprichii | | | | | | | | | O | | | | | | |
| Scolymia sp. cf S. vitiensis | | | | | | | | | | | | | | | R |
| Symphyllia recta | | | | | | | | | | | | | | | |
| Symphyllia sp. | | | | | | | | | | | | | | | |
| Symphyllia valenciennesii | | | | | | | | | | | | | | | |
| Fam. Oculinidae | | | | | | | | | | | | | | | |
| Acrhelia horrescens | | | | | | | R | | R | | | | | | |
| Galaxea fascicularis | | | | A | | | | | | | | | | | |
| Galaxea sp. (explanate) | | | | | | | | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | | | | | | | | |
| Echinophyllia aspera | | | | | R | | | | | | | | | | |
| Mycedium elephantotus | | | | R | | | C | C | | | | | | | |
| Oxypora lacera | | | | | | | | | | | | | | | |
| Pectinia lactuca | | | | | | | | | | | | | | | |
| Pectinia paeonia | | | | O | | | R | C | | | | | | | O |
| Fam. Pocilloporidae | | | | | | | | | | | | | | | |
| Pocillopora damicornis | C | | | | | | | | | | | | | | O |
| Pocillopora elegans | | | | | | | | | | | | | | | |
| Pocillopora eydouxi | O | | | O | | | | | | | | | | | |
| Pocillopora ligulata* | | | | | | | | | | | | | | | |
| Pocillopora meandrina | | R | | | | | | | | | | | | | |
| Pocillopora sp. (bottlebrush)* | | | | O | R | | | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | | | | | | | | |
| Pocillopora verrucosa | C | O | | O | O | | | | | | | | | | |
| Seriatopora hystrix | | | | | | | | | | | | | | | |
| Stylophora pistillata | C | C | | O | R | | | | | | | | | | |
| Fam. Poritidae | | | | | | | | | | | | | | | |
| Alveopora allingi | | | | | | | | | | | | | | | |
| Goniopora arbuscula* | | | | | | | | | | | | | | | |
| Goniopora columna | | | | R | O | | | | | | | | | | |
| Goniopora fruticosa | | | | | | | C | | C | | | | | | |
| Goniopora lobata | | | | | R | | O | O | | | | | | | |
| Goniopora spp. | | | | | | O | C | O | O | | | | | | |
| Porites (N) vaughani | | | | | | | | | | | | | | | |
| Porites (S) rus | | | | | A | | | | A | | | | | | |
| Porites australiensis | | | | A | | | | | C | | | | | | |
| Porites cocosensis* | | | | | | | | | | | | | | | |
| Porites cylindrica | | | | | R | | A/D | A | A/D | | | | O | | C |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 4

| STATION No. | 9a | 9c | 9b | 9 | 10 | 10a | 10b | 10c | 10d | 10e | 10f | 10g | 10h | 10j | 10k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Porites horizontalata* | | | | | | | | | | | | | | | |
| Porites lichen | | | | O | O | | | | | | | | | | |
| Porites lobata | C | | | | | | | | O | | | | | | O |
| Porites lutea | A | | | A | | C | | D | C | | | | C | | C |
| Porites murrayensis | | | | | | | | | | | | | | | |
| Porites nigrescens | | | | | O | | | | | | | | | | |
| Porites sp. cf P. crassatellata* | | | | | R | | | | | | | | | | |
| Porites sp. cf P. tenuis* | | | | | | | | | | | | | | | |
| Porites solida | | | | C | | O | | O | | | | | | | |
| Porites superfusa | | | | | | | | | | | | | | | |
| Fam. Rhizangiidae | | | | | | | | | | | | | | | |
| Culicia rubeola* | | | | | | | | | | | | | | | |
| Fam. Siderastreidae | | | | | | | | | | | | | | | |
| Coscinaraea columna | | | | | | O | | | | | | | | | C |
| Coscinaraea wellsi | | | | | | C | O | | O | | | | | | O |
| Fam. Stylasteridae | | | | | | | | | | | | | | | |
| Distichopora gracilis | | | | | | | | | | | | | | | |
| Fam. Thamnasteriidae | | | | | | | | | | | | | | | |
| Psammocora contigua | C | | | | | O | | | | | | | | | |
| Psammocora digitata | O | | | O | | | | C | | | | | | | |
| Psammocora haimeana | | | | | | | | | | | | | | | |
| Psammocora profundacella | | | | R | | | | | | | | | | | |
| Psammocora stellata | O | | | | | | | | | | | | | | |
| Psammocora superficialis | | | | | | O | | | | | | | | | |
| Fam. Tubiporidae | | | | | | | | | | | | | | | |
| Tubipora musica | | | | R | | | | | | | | | | | |
| Order Antipatharia (black corals) | | | | | | | | | | | | | | | |
| Cirrhipathes sp. | | | | | | | | | | | | | | | O |

* = Species reported only prior to 1987 survey

Appendix d
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STONY CORALS | | | | | | | | | | | |
| PHYLUM CNIDARIA | | | | | | | | | | | |
| Fam. Acroporidae | | | | | | | | | | | |
| Acropora (I) cuneata | | | | | | | | A | C | | |
| Acropora (I) palifera | O | | | | A | | A | A | | | |
| Acropora acuminata | | | | | O | | | | | | A |
| Acropora aspera | | | | | | | | | | | |
| Acropora austera | | | | | | | | | | | |
| Acropora cerealis | | | | | | | | | | | |
| Acropora cytherea | | | | | C | | C | | | C | |
| Acropora danai | | | | | | | | | | | |
| Acropora digitifera | | | | | | | | | | | |
| Acropora divaricata | | | | | | | | | | | |
| Acropora echinata | | | | | | | | | | | |
| Acropora florida | | | | O | O | | C | C | | C/A | |
| Acropora formosa | O | C | | | C/A | | C | | C | | |
| Acropora glauca | | | | | | | | | | | |
| Acropora grandis | | | | | | | | | | | |
| Acropora hebes | | | | | | | | | | | |
| Acropora horrida | | | | | | | | | | | |
| Acropora humilis | | C | | | | | | | | | |
| Acropora hyacinthus | | | | | | | A | | C | | |
| Acropora irregularis | | | | | | | | | A | | |
| Acropora monticulosa | | | | | | | | | | | |
| Acropora nana | | | | | | | | | | | |
| Acropora nasuta | | | | | | | | R | C | | |
| Acropora nobilis | | | | | | | | | | | |
| Acropora palmerae | | | | | | | | | | | |
| Acropora paniculata | | | | | | | | | | | |
| Acropora polymorpha* | | | | | | | | | | | |
| Acropora robusta* | | | | | | | | | | | |
| Acropora sp. cf secunda* | | | | | | | | | | | |
| Acropora sp. (blue)* | | | | O | | | | | | | |
| Acropora surculosa | | | | | | | | | C | C | |
| Acropora teres | | | | | | | | | | | |
| Acropora valida | | | | | | | | | | | |
| Acropora vaughani | | | | | | | | | O | | |
| Astreopora myriophthalma | | | | | | | | | R | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Astreopora sp. | | | | | | | | | | | |
| Montipora acanthella* | | | | | | | | | | | |
| Montipora aequituberculata | O | | | | | | | | | | |
| Montipora berryi* | | | | | | | | | | | |
| Montipora caliculata | | | | | | | | | | | |
| Montipora carinata* | | | | | | | | | | | |
| Montipora circumuallata* | | | | | | | | | | | |
| Montipora danae | | | | | | | | | | | |
| Montipora digitata | | | | | | | | | | | |
| Montipora ehrenbergii* | | | | | | | | | | | |
| Montipora foliosa | | C/A | | | | | | | | | C |
| Montipora foveolata | | | | | | | C | C | | | |
| Montipora hispida | | | | | | | | | | | |
| Montipora hoffmeisteri | | | | | | | | | | | |
| Montipora informis | | | | C | | | | | | | |
| Montipora sp. cf intricata* | | | | | | | | | | | |
| Montipora lobulata | | | | | | | | | | | O |
| Montipora monasteriata | | | | O | | | | | | | |
| Montipora nodosa* | | | | | | | | | | | |
| Montipora spumosa* | | | | | | | | | | | |
| Montipora tuberculosa | | | | | | | | C | O | C | |
| Montipora turgescens | | | | | | | | | | | |
| Montipora undata* | | | | | | | | | | | |
| Montipora verrucosa | R | | | | | | O | | R | | |
| Fam. Agariciidae | | | | | | | | | | | |
| Gardineroseris planulata | | | | | | | | | | | |
| Leptoseris columna | | | | | | | | | | | |
| Leptoseris incrustans | | | | | | | | | | | |
| Leptoseris mycetoseroides | | | | R | | | R | | | | |
| Leptoseris scabra | | | | | | | | | | | |
| Leptoseris yabai | | | | | | | | | | | |
| Leptoseris sp. | | | | | | | | | | | |
| Pachyseris rugosa | C | | | | O | | C | | C | C | |
| Pachyseris speciosa | | O | | | R | | | | | | |
| Pavona cactus | | | | | | | | | | | |
| Pavona clavus | | | | | | | | | | | |
| Pavona decussata | | | | C | | | | | | | |
| Pavona divaricata | | | | | | | | | | | |
| Pavona explanulata | | | | | | | | | | | |
| Pavona frondifera | | | | | | | | | | | |
| Pavona maldivensis | | | | | | | | | | | |
| Pavona varians | O | O | | | | | | | O | O | |
| Pavona venosa | | | | | | | | | | | |
| Pavona sp. (explanate) | | | | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Astrocoeniidae | | | | | | | | | | | |
| Stylocoeniella armata | | | | O | | | | | | O | O |
| Fam. Caryophylliidae | | | | | | | | | | | |
| Euphyllia glabrescens | | | | | | | | | | | |
| Euphyllia sp. | | | | | | | | | | | |
| Physogyra lichtensteini | | C | | | | | | | | | |
| Fam. Dendrophylliidae | | | | | | | | | | | |
| Tubastraea micrantha* | | | | | | | | | | | |
| Tubastraea coccinea | | R | | | | | | | | | |
| Turbinaria stellulata | | | | | C | | | | | C | |
| Fam. Faviidae | | | | | | | | | | | |
| Barabattoia mirabilis | | | | | | | | | | | |
| Caulastrea furcata | | | | | | | | | | | |
| Cyphastrea chalcidium | R | | | | | | | | O | | |
| Cyphastrea microphthalma | O | C | | O | | O | O | C | | C | C |
| Cyphastrea serailea | | | | | | | | | | | R |
| Cyphastrea sp. | | | | | | | | | | | |
| Diploastrea heliopora | O | O | | | | | C | | C | C | |
| Echinopora lamellosa | O | | | | C | | O | R | A | C | |
| Echinopora sp. cf E. horrida | | | | | | | | | | | |
| Favia danae | | | | | | | | | | | |
| Favia favus | | | | | | | | | | | |
| Favia laxa | | | | | | | O | | C | C | |
| Favia matthaii | | | | | | | | | | | |
| Favia pallida | C | C/A | | C | | R | O | | C | | |
| Favia rotumana | | | | | | | | | | | |
| Favia sp. rotundata | | | | | | | | | | | |
| Favia speciosa | | | | C | | | | | | | |
| Favia stelligera | | | | | | | | C | C | C | O |
| Favites abdita | | C/A | | C | | | | A | | O | |
| Favites chinensis | | | | | | | | | | | |
| Favites sp. cf F. complanata* | | | | | | | | | | | |
| Favites flexuosa | | O | | C | | | | | | | C |
| Favites pentagona | | | | | | | | | | | |
| Favites sp. | | | | | | | | O | | | |
| Goniastrea edwardsi | | | | | | | | | | | |
| Goniastrea palauensis | | | | | | | | | | | |
| Goniastrea pectinata | O | | | C | O | | | | O | | |
| Goniastrea retiformis | C | | | | | | | C | O | C | |
| Hydnophora exesa | | O | | | | | | | | | |
| Hydnophora microconos | | | | | O | | O | C/A | R | O | |
| Hydnophora rigida | | | | | O | | | R | O | | O |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Leptastrea bottae | O | | | | | | | C | | | |
| Leptastrea purpurea | R | | | | O | R | C | | O | | |
| Leptastrea transversa | R | | | | | | R | | O | | |
| Leptoria phrygia | C | C | | | | | C | C | C | C | |
| Montastrea sp.* | | | | | | | | | | | |
| Oulophyllia crispa | | | | | R | | | | R | R | |
| Platygyra daedalea | | | | | C | | C | C/A | A | C | |
| Platygyra lamellina | | | | | | | | | | | |
| Platygyra pini | | | | | | | | | R | | |
| Plesiastrea versipora | O | | | | | | | | | | |
| Fam. Fungiidae | | | | | | | | | | | |
| Cycloseris costulata | | | | | | | | | | | |
| Fungia (C) echinata | | C | | | | | | | | | C |
| Fungia (D) concinna | | C | | | | | | O | O | | O |
| Fungia (D) danai | | | | D | | | | | | | |
| Fungia (P) paumotensis | | | | | | | | | | | |
| Fungia (P) scutaria | | | | | R | | | | | | R |
| Fungia fungites | | | | C | | | | | | | |
| Halomitra pileus | | | | | R | | R | | | | |
| Heliofungia actiniformis | | | | | | | | | | | |
| Herpolitha limax | | | | | | | | | | | |
| Polyphyllia talpina | | | | | | | | | | | |
| Sandalolitha robusta | | | | | O | | | | | | |
| Fam. Helioporidae | | | | | | | | | | | |
| Heliopora coerulea | | | | | | | | C | | | |
| Fam. Merulinidae | | | | | | | | | | | |
| ?Clavarina triangularis | | | | | | | | | | | |
| Merulina ampliata | R | C | | O | | | | | O | | |
| Merulina sp. | | | | | | | | | | | |
| Scapophyllia cylindrica | | | | | | | | | | | |
| Fam. Milleporidae | | | | | | | | | | | |
| Millepora dichotoma | | C/A | | C | | | | A | | | |
| Millepora intricata* | | | | | | | | | | | |
| Millepora platyphylla | | | | | | | | O | | O | |
| Millepora exaesa | | | | | | | O | C | | | A |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 11 | 11a | 12a | 12b | 12 | 13a | 13 | SECTION 6 14a | 14 | 15 | 15a |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | | | | |
| Lobophyllia corymbosa | | R | | | | | | | O | O | |
| Lobophyllia hataii | | | | | | | | | | | |
| Lobophyllia hemprichii | | | | | | | | | C | O | |
| Scolymia sp. cf S. vitiensis | | | | | | | | | | | |
| Symphyllia recta | | | | | | | | | O | | |
| Symphyllia sp. | | | | | | | | | | | |
| Symphyllia valenciennesii | R | | | | | | R | | R | | |
| Fam. Oculinidae | | | | | | | | | | | |
| Acrhelia horrescens | | C | | | | | | | | | O |
| Galaxea fascicularis | A | O | | | O | | | | C | | |
| Galaxea sp. (explanate) | | O | | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | | | | |
| Echinophyllia aspera | | | | | O | | O | | C | O | |
| Mycedium elephantotus | | C | | | | | C | | C | C | |
| Oxypora lacera | | | | | | | | | | R | |
| Pectinia lactuca | | | | | | | | | | | |
| Pectinia paeonia | | | | | | | | | | | O |
| Fam. Pocilloporidae | | | | | | | | | | | |
| Pocillopora damicornis | | | | | | | | C | | | O |
| Pocillopora elegans | | | | | | | | | | | |
| Pocillopora eydouxi | | | | | | | | | | O | |
| Pocillopora ligulata* | | | | | | | | | | | |
| Pocillopora meandrina | | | | | | | C | | | | |
| Pocillopora sp. (bottlebrush)* | | | | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | | | | |
| Pocillopora verrucosa | | | | O | C | | | C | | C | |
| Seriatopora hystrix | O | | | | | | | | | | |
| Stylophora pistillata | O | | | | C | | C | C | C | | C |
| Fam. Poritidae | | | | | | | | | | | |
| Alveopora allingi | | | | | | | | | | | |
| Goniopora arbuscula* | | | | | | | | | | | |
| Goniopora columna | | | | | | | | | | | |
| Goniopora fruticosa | | | | | | | | | | | |
| Goniopora lobata | | O | | | | | | | | | |
| Goniopora spp. | | | | | | | | | | | O |
| Porites (N) vaughani | O | O | | | | | | | O | | |
| Porites (S) rus | A/D | O | | C/A | A | | | | C | | C |
| Porites australiensis | A | | | | C | | O | | O | | A |
| Porites cocosensis* | | | | | | | | | | | |
| Porites cylindrica | R | | | | | | | C | | | A |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 5 | | | | | | | SECTION 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | 11a | 12a | 12b | 12 | 13a | 13 | 14a | 14 | 15 | 15a |
| Porites horizontalata* | | | | | | | | | | | |
| Porites lichen | C | C | | O | | | | | | | C |
| Porites lobata | | C | | | C | O | C | C | | A | C |
| Porites lutea | | | | | O | C | | A | | | A |
| Porites murrayensis | | | | O | | | | | | | |
| Porites nigrescens | | | | | | | | | | | |
| Porites sp. cf P. crassatellata* | | | | | | | | | | | |
| Porites sp. cf P. tenuis* | | | | | | | | | | | |
| Porites solida | | | | | | | O | | O | | R |
| Porites superfusa | O | | | | | | | | | | |
| Fam. Rhizangiidae | | | | | | | | | | | |
| Culicia rubeola* | | | | | | | | | | | |
| Fam. Siderastreidae | | | | | | | | | | | |
| Coscinaraea columna | | | | | | | | | | R | R |
| Coscinaraea wellsi | | | | | | | | | | | |
| Fam. Stylasteridae | | | | | | | | | | | |
| Distichopora gracilis | | | | | | | | | | | |
| Fam. Thamnasteriidae | | | | | | | | | | | |
| Psammocora contigua | | | | | | | | | | | |
| Psammocora digitata | | | | R | R | | | | O | | |
| Psammocora haimeana | | R | | | | | | | | | |
| Psammocora profundacella | | | | | | | | | | | |
| Psammocora stellata | | | | | | | | R | | | |
| Psammocora superficialis | | | | | R | | | | | | |
| Fam. Tubiporidae | | | | | | | | | | | |
| Tubipora musica | | | | | O/C | | O | | | C | |
| Order Antipatharia (black corals) | | | | | | | | | | | |
| Cirrhipathes sp. | | O | | | | | | | | | R |

* = Species reported prior to 1987 survey

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 7 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| STONY CORALS | | | | | | | | |
| PHYLUM CNIDARIA | | | | | | | | |
| fam. Acroporidae | | | | | | | | |
| Acropora (I) cuneata | | | | | C | | | |
| Acropora (I) palifera | | C | | | O | | | |
| Acropora acuminata | C | A | | | | C | A | |
| Acropora aspera | | A | | | | | | O |
| Acropora austera | | | | | | | | |
| Acropora cerealis | | | | | | | | |
| Acropora cytherea | | C | | | | | O | |
| Acropora danai | | | | | | | | |
| Acropora digitifera | | C | | C | | A | C | |
| Acropora divaricata | | | | | | | | |
| Acropora echinata | R | | | O | | | A | |
| Acropora florida | | C | | | | | | |
| Acropora formosa | | O | | | C | | | |
| Acropora glauca | | | | | | | | |
| Acropora grandis | | | | | C/A | | A | |
| Acropora hebes | | | | | | | | |
| Acropora horrida | | | | | | | | |
| Acropora humilis | | C | | | | | | |
| Acropora hyacinthus | O | C | | | | C | | |
| Acropora irregularis | | O | | | C | | | |
| Acropora monticulosa | | | | | | | | |
| Acropora nana | | | | | | | | |
| Acropora nasuta | | R | | | | | | |
| Acropora nobilis | | | | | | | | |
| Acropora palmerae | | | | | | | | |
| Acropora paniculata | | | | | | | | |
| Acropora polymorpha* | | | | | | | | |
| Acropora robusta* | | | | | | | | |
| Acropora sp. cf secunda* | | | | | | | | |
| Acropora sp. (blue)* | C | | | | | | | |
| Acropora surculosa | | C | | | | | | |
| Acropora teres | | | | | | | O | |
| Acropora valida | | | | | | | | |
| Acropora vaughani | | | | | | | O | |
| Astreopora myriophthalma | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

SECTION 7

| STATION No. | 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Astreopora sp. | | | | | | | | |
| Montipora acanthella* | | | | | | | | |
| Montipora aequituberculata | | | | | | | | |
| Montipora berryi* | | | | | | | | |
| Montipora caliculata | | | | | | | D | |
| Montipora carinata* | | | | | | | | |
| Montipora circumuallata* | | | | | | | | |
| Montipora danae | | | | | | | O | |
| Montipora digitata | | | | | | O | | |
| Montipora ehrenbergii* | | | | | | | | |
| Montipora foliosa | C | A/D | | | | | C | |
| Montipora foveolata | | | | | | | | |
| Montipora hispida | | | | | | | | |
| Montipora hoffmeisteri | | | | R | | | R | |
| Montipora informis | | | | | | O | O | |
| Montipora sp. cf intricata* | | | | | | | | |
| Montipora lobulata | O | | | | | | | O |
| Montipora monasteriata | R | | | | | | | |
| Montipora nodosa* | | | | | | | | |
| Montipora spumosa* | | | | | | | | |
| Montipora tuberculosa | | | | | | | | |
| Montipora turgescens | | | | | | | | |
| Montipora undata* | | | | | | | | |
| Montipora verrucosa | | | | | | | | |
| Fam. Agariciidae | | | | | | | | |
| Gardineroseris planulata | | | | R | C | R | | |
| Leptoseris columna | | | | | | | | |
| Leptoseris incrustans | | | | R | | | | |
| Leptoseris mycetoseroides | | | | | | | | |
| Leptoseris scabra | O | | | | | | O | |
| Leptoseris yabai | | | | | | | R | |
| Leptoseris sp. | | | | | | | | |
| Pachyseris rugosa | | C | | R | C | | O | |
| Pachyseris speciosa | R | | | O | | O | O | R |
| Pavona cactus | | | | | | O | | |
| Pavona clavus | | | | | | | | |
| Pavona decussata | | | | | | | | |
| Pavona divaricata | | | | | | | | |
| Pavona explanulata | | | | | | | | |
| Pavona frondifera | | | | | | | | |
| Pavona maldivensis | | | | | | | | |
| Pavona varians | C | O | | C | C | O | O | |
| Pavona venosa | R | | | | | O | C | |
| Pavona sp. (explanate) | | | | | | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during teh YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 7 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Fam. Astrocoeniidae | | | | | | | | |
| Stylocoeniella armata | C | C | | | | O | | R |
| Fam. Caryophylliidae | | | | | | | | |
| Euphyllia glabrescens | | | | | | | | |
| Euphyllia sp. | | | | | | | | |
| Physogyra lichtensteini | C | R | | | | | C | |
| Fam. Dendrophylliidae | | | | | | | | |
| Tubastraea micrantha* | | | | | | | | |
| Tubastraea coccinea | | | | | | | | |
| Turbinaria stellulata | C | C | | | C | | | |
| Fam. Faviidae | | | | | | | | |
| Barabattoia mirabilis | | | | | | | | |
| Caulastrea furcata | | | | O | | | O | |
| Cyphastrea chalcidium | | | | | | | | |
| Cyphastrea microphthalma | C | | | O | | O | O | |
| Cyphastrea serailea | | O | | | | | | |
| Cyphastrea sp. | | | | | | | | |
| Diploastrea heliopora | C | C | | | | | O | |
| Echinopora lamellosa | C | C | | | C/A | O | O | |
| Echinopora sp. cf E. horrida | | | | | | | | |
| Favia danae | | | | | | | | |
| Favia favus | | | | | | | R | |
| Favia laxa | | C | | | | | | |
| Favia matthaii | | | | | | | | |
| Favia pallida | C | | | C | C | O | C | A |
| Favia rotumana | | | | | | | | |
| Favia sp. rotundata | C | R | | R | | | | |
| Favia speciosa | | | | | | | | |
| Favia stelligera | | C | | | A | C | | |
| Favites abdita | | O | | C | | O | | A |
| Favites chinensis | | | | | | | | |
| Favites sp. cf F. complanata* | | | | | | | | |
| Favites flexuosa | | C | | O | | O | O | C |
| Favites pentagona | | | | | | | | |
| Favites sp. | | | | | | | | |
| Goniastrea edwardsi | | | | | | | | |
| Goniastrea palauensis | | | | | | | | |
| Goniastrea pectinata | | C | | R | | O | O | C |
| Goniastrea retiformis | C | C | | C | | | | |
| Hydnophora exesa | | C | | | | | | |
| Hydnophora microconos | O | O | | | | O | | |
| Hydnophora rigida | C | O | | | C | O | O | R |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 7 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Leptastrea bottae | | | | | | | | |
| Leptastrea purpurea | O | O | | O | | | R | C |
| Leptastrea transversa | | O | | | | | | O |
| Leptoria phrygia | C | C | | O | C/A | O | O | |
| Montastrea sp.* | | | | | | | | |
| Oulophyllia crispa | O | | | | O | R | | |
| Platygyra daedalea | O | C | | C | C | | O | |
| Platygyra lamellina | | | | | | | R | C |
| Platygyra pini | | | | | | | | |
| Plesiastrea versipora | | R | | | | | | |
| Fam. Fungiidae | | | | | | | | |
| Cycloseris costulata | | | | | | | | |
| Fungia (C) echinata | | | | O | C | C | C | |
| Fungia (D) concinna | O | | | | O | | O | |
| Fungia (D) danai | O | | | | | | | |
| Fungia (P) paumotensis | | | | | | | | |
| Fungia (P) scutaria | | | | | O | | | |
| Fungia fungites | | | | O | | O | O | |
| Halomitra pileus | | | | | | | | |
| Heliofungia actiniformis | | O | | | | | | |
| Herpolitha limax | | | | | | | | |
| Polyphyllia talpina | | | | | | | | |
| Sandalolitha robusta | | | | | O | | | |
| Fam. Helioporidae | | | | | | | | |
| Heliopora coerulea | | | | | | | | |
| Fam. Merulinidae | | | | | | | | |
| ?Clavarina triangularis | | | | | | | | |
| Merulina ampliata | C | | | C | A | C | C | |
| Merulina sp. | | | | | | | | |
| Scapophyllia cylindrica | | R | | | | | | |
| Fam. Milleporidae | | | | | | | | |
| Millepora dichotoma | O | C | | O | | O | | |
| Millepora intricata* | | | | | | | | |
| Millepora platyphylla | | | | | | | R | |
| Millepora exaesa | O | O | | C | C | | | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | SECTION 7 16a | 16b | 16d | 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Fam. Mussidae | | | | | | | | |
| Cynarina lacrymalis | | | | | | | | |
| Lobophyllia corymbosa | R | O | | R | | | C | C |
| Lobophyllia hataii | | | | | | | | |
| Lobophyllia hemprichii | | O | | | O | | | |
| Scolymia sp. cf S. vitiensis | | | | | | R | O | O |
| Symphyllia recta | | | | | | | | |
| Symphyllia sp. | | | | | | | | |
| Symphyllia valenciennesii | R | | | O | R | R | | |
| Fam. Oculinidae | | | | | | | | |
| Acrhelia horrescens | C | | | | | | C | |
| Galaxea fascicularis | O | C | | O | | R | | |
| Galaxea sp. (explanate) | | | | | | | | |
| Fam. Pectiniidae | | | | | | | | |
| Echinophyllia aspera | C | O | | | O | O | | |
| Mycedium elephantotus | C | C | | R | C | O | O | |
| Oxypora lacera | | | | R | O | | | |
| Pectinia lactuca | | | | | | | | |
| Pectinia paeonia | | | | O | | C | C | |
| Fam. Pocilloporidae | | | | | | | | |
| Pocillopora damicornis | | C | | | | | C | O |
| Pocillopora elegans | | | | | | | | |
| Pocillopora eydouxi | | O | | | | | | |
| Pocillopora ligulata* | | | | | | | | |
| Pocillopora meandrina | | C | | | | | | |
| Pocillopora sp. (bottlebrush)* | | | | | | | | |
| Pocillopora sp. cf molokensis* | | | | | | | | |
| Pocillopora verrucosa | C | C | | | C/A | O | | |
| Seriatopora hystrix | C | O | | C | C | A | C | |
| Stylophora pistillata | C | | | C | A | C | O | |
| Fam. Poritidae | | | | | | | | |
| Alveopora allingi | | | | | C | | | |
| Goniopora arbuscula* | | | | | | | | |
| Goniopora columna | | | | | | | | |
| Goniopora fruticosa | C | | | C | | | C | |
| Goniopora lobata | C | O | | | O | O | O | |
| Goniopora spp. | O | | | | | | | |
| Porites (N) vaughani | | O | | | | | | |
| Porites (S) rus | C | A | | A | C | C | A | A |
| Porites australiensis | A | | | C | C | | | |
| Porites cocosensis* | | | | | | | | |
| Porites cylindrica | | A | | A | | D | A | |

Appendix D
(cont'd)

Conspicuous coral species observed during the YCRI survey.

YAP ISLANDS SPECIES LIST

| STATION No. | 16a | 16b | 16d | SECTION 7 17a | 17 | 18a | 18b | 18c |
|---|---|---|---|---|---|---|---|---|
| Porites horizontalata* | | | | | | | | |
| Porites lichen | A | C | | | C/A | C | | |
| Porites lobata | | | | | | | O | |
| Porites lutea | A | O | | A | | A | | D |
| Porites murrayensis | | | | | | | | |
| Porites nigrescens | | | | | | | | |
| Porites sp. cf P. crassatellata* | | | | | | | | |
| Porites sp. cf P. tenuis* | | | | | | | | |
| Porites solida | | | | | | | O | |
| Porites superfusa | | | | | | | | |
| Fam. Rhizangiidae | | | | | | | | |
| Culicia rubeola* | | | | | | | | |
| Fam. Siderastreidae | | | | | | | | |
| Coscinaraea columna | | | | O | | | | R |
| Coscinaraea wellsi | | | | | | | | |
| Fam. Stylasteridae | | | | | | | | |
| Distichopora gracilis | | C | | | | | | |
| Fam. Thamnasteriidae | | | | | | | | |
| Psammocora contigua | | | | | | | O | |
| Psammocora digitata | R | | | | | R | | O |
| Psammocora haimeana | | | | | | | | |
| Psammocora profundacella | R | | | | | | | |
| Psammocora stellata | | | | | | | | |
| Psammocora superficialis | | | | | | | | |
| Fam. Tubiporidae | | | | | | | | |
| Tubipora musica | R | | | | C | | | |
| | | C | | | | | | |
| Order Antipatharia (black corals) | | | | | | | | |
| Cirrhipathes sp. | | | | | | | | |

* = Species reported only prior to 1987

**Appendix E. YCR interview categories used during the YCRI interview sessions.**

| | | |
|---|---|---|
| 1. | Taguw | Tuna |
| 2. | Yasul | Dogtooth tuna |
| 3. | Gooychaaf, Gadaw | Snappers |
| | Wachaqmal | Large eye bream |
| 4. | Smaak'uw, K'uw | Groupers |
| 5. | Qelbad, Qalaabal, Malngoed | Parrot fish |
| 6. | Quum, Maath | Unicorn fish |
| 7. | Quloch, Galaed | Mullet |
| 8. | Yooch | Squirrel fish |
| 9. | Dayit, Garmiy, Buywood, Darruy, Limreq | Rabbit fish |
| 10. | Manguch, Mbing, Soong | Goat fish |
| 11. | Maal' | Barracuda |
| 12. | Saadiin | Sardines |
| 13. | Malmeq | Anchovies |
| 14. | Foofow | Rainbow Runner |
| | Thilbuw | Fusiliers |
| 15. | Ngool, M'uul, Qelgel | Jacks |
| 16. | Qutun | Breams |
| 17. | Daak' | Damsel fish |
| | Wul', Qoeyeq, Gadgad | Emperors |
| 18. | Geap | Butterfly fish |
| 19. | Qeer, Buloch | Angel fish |
| 20. | Numeam | Wrasses |
| 21. | Buuy | Needle fish |
| 22. | Wuuq, Moelngith, Nguur | Trigger fish |
| 23. | Kaahool | Box fish |
| 24. | Guumiy | Rudder fish |
| 25. | Guuguw, juvenile (smaller), Tangir (full grown) | Milk fish |
| 26. | Faakeayaan', Liyeq, (mangrove silverfish), ganger | Flagtail & Silver fish |
| 27. | Goeg | Flying fish |
| 28. | Quchwaq | Sea grass parrot fish |
| 29. | Pathuuy | Mackerel |
| 30. | Qachwog, Qanger | Silver fish |
| 31. | Machagwog, Bilaew | Surgeon fish |
| 32. | Gamaygul | Bumper head parrot fish |
| 33. | Malchath | Wahoo |
| 34. | Dabaar | Mahi Mahi |
| 35. | Looth | Eel |
| 36. | L'ugul | Sea cucumbers |
| 37. | Weel | Turtle |
| 38. | Qey | Sea grass area |
| 39. | K'aay | Octopus |
| 40. | Qaraangoey | Lobster |
| 41. | Qamaang | Mangrove crab |
| 44. | Qurich (young mangrove crab) | Swimming crab |
| 45. | Faasuw, tow | Clams |
| 46. | Yungwol | Mud clams |
| 47. | Yogyog | Top shells |
| 48. | Ganeef | Freshwater shrimp |

**Appendix E. (Con't) YCR interview categories used during the YCRI interview sessions .**

| | | |
|---|---|---|
| 49. | Qaaf (village) sand | Sand dredging area |
| 50. | Qech | Stone fish trap |
| 51. | Yanup | Wooden/bamboo traps |
| 52. | Saagel | Bamboo fish traps |

**Appendix F. Fishermen Interviewed During Phase I of the Yap Coastal Resources Inventory. Fishermen are listed by Municipality and the date of the interview session.**

RUMUNG: 10/17/86

Louis Sopluw
Waayan
Libyan

DALIPEEBINAEW: 10/13/86

Falagurang
G. Rabee
Marimed
Minginfal

GILMAAN: 10/13/86

Funugchel
Yuwun
Thaley
Liyey
Fas
Keufal
Tanag
Waayan
Falag
Falan

KANIFAAY: 10/13/88

Anow
Magar
Sawayog
Folbuw
Nruw
Faimau
Forong
Datmag
Yinrow
Gubung
Ruot
Gasag
Fanathin
Kanang
Alex

RUUL: 10/16/86

Yilon
Kaded
Jesus Betmag

FANIF & WEELOEY: 10/14/86

Gililang
Falamar
Funugmar
Beengin
Paatmag

TAMIL: 10/15/86

Moofal
Tamngig
Tamagchoy
Reunechugract
Falmeyog
Gilmoon

GAGIL: 10/15/86
Louis Pitmag
Manefel

MAAP: 10/16/88

Kenrick
Yow
Tomaq

## APPENDIX G. Trust Territory of the Pacific Islands Classification of Coastal Waters.

### Class AA Waters

-The uses to be protected in this class of waters are oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, compatible recreation and aesthetic enjoyment.

-It is the objective of this class of waters that they remain in as nearly their natural, pristine state as possible with an absolute minimum of pollution from any sources. To the extent possible, the wilderness character of such areas shall be protected. No zone of mixing will be permitted in these waters.

### Class A Waters

-The uses to be protected in this class of waters are recreational (including fishing, swimming, bathing, and water contact sports), aesthetic enjoyment, and the support and propagation of marine life.

-It is the objective of this class of waters that their recreational purposes and aesthetic enjoyment not be limited in any way. Such waters shall be kept clean of trash, solid materials or oils, and shall not act as receiving waters for any effluent which has not received the best degree of treatment and control practicable under existing technology and compatible with the standards established for this class.

### Class B Waters

-The uses to be protected in this class of waters are small boat harbors, commercial and industrial shipping, bait fishing, compatible recreation, the support and propagation of aquatic life and aesthetic enjoyment.

-It is the objective of this class of waters that discharges of any pollutant be controls to the maximum degree possible and that sewage and industrial effluents receive the best degree of treatment control practicable under existing technology and compatible with the standards established for this class.

-The Class B designation shall apply only to a limited area next to the boat docking facilities in bays and harbors. The rest of the water in the area in such bay or harbor shall be Class A.

**APPENDIX H. Definitions for relative abundance terms for each marine resource category based on a twenty minute survey period, in most situations.**

A. ALGAE & SEAGRASSES
Abundant (A) = greater than 20 percent coverage.
Common (C) = between 1 percent and 20 percent coverage.
Rare (R) = less than 1 percent coverage.

B. FISH
Abundant (A) = 16 or more individuals observed.
Common (C) = 6 to 15 individuals observed.
Occasional (O) = 2 to 5 individuals observed.
Rare (R) = 1 individual observed.

C. INVERTEBRATES
Dominant (D) = greater than 50 percent coverage in a zone.
Abundant (A) = greater than 20 percent coverage in a zone.
Common (C) = 8 to 20 individuals observed of a species.
Occasional (O) = 2 to 7 individuals observed of a species.
Rare (R) = 1 individual observed.

D. CORAL

| TERM | ABUNDANCE WITHIN A ZONE OR HABITAT TYPE | ABUNDANCE ON THE REEF AS A WHOLE |
|---|---|---|
| Dominant (D) | The coral constitutes a majority in abundance or coverage (50% or more of total). | Coral contributes substantial abundance or coverage (25% of more) or coral conspicuous in all zones. |
| Abundant (A) | Coral contributes substantial abundance or coverage or is very numerous. | Coral conspicuous in most zones or is dominant within a single zone. |
| Common (C) | Coral present as several or more individuals or as a few larger individuals. | Coral conspicuous in only one or a few zones or locally substantial in a single zone. |
| Occasional (O) | Uncommon or present only as a few individuals or present as a single conspicuous individual. | Present more than once, but only within a single zone. |
| Rare (R) | Reported only once as an inconspicuous individual. | Reported only once from the reef as a whole. |

## GLOSSARY

**Beach:** A sand, gravel, or rocky area along the shoreline and adjacent to the water's edge.

**Embayment:** A semi-enclosed area like a bay. Examples in Yap include Tamil Harbor, Miil and Quaniif.

**Ecotype:** A specific environment with similar plant and animal life. For the YCRI, the following ecotypes have been determined: mangrove, seagrass, coral reef, embayment, beach, lagoon hole, reef pass, and ocean reef areas

**Fore reef:** the seaward side of the ocean coral reef.

**Islet:** A small island located offshore of the four main Yap islands. On Yap there are 7 islets: Dilmeet, Ruunguch, Paakeal, Taraang, Biy, Donitsch, and Garim.

**Landward:** Toward the land or the interior.

**Leeward:** The west side of the Yap islands complex or Yap Proper.

**Mangrove:** *(Malil)* a group of vegetation occurring in saltwater-influenced areas which are dominated by a member of the mangrove family, Rhizophoraceae.

**Microatoll:** a single pancake-shaped colony of massive corals which has live coral growth on its sides and a dead upper surface which is frequently exposed at low tides. Most microatolls in Yap are constructed by corals of the genus Porites.

**Non-Point source pollution:** discharges having no single identifiable source of pollution discharge. Examples include rain water runoff during heavy rains, chemical leaching from road surfaces, and leacheates from filled lands.

**Point source pollution:** discharges from an identifiable source such as sewage outfalls, over-the-water toilets (benjos), or pig pen discharges.

**Reef flat:** The flat shallow area between the coral reef slope and the shoreline for fringing reefs. For barrier reefs, the shallow flat area of the reef between its lagoon and ocean facing margins.

**Seaward:** Toward the sea or outer reef.

**Windward:** The east side of the Yap islands complex or Yap Proper which directly faces the prevailing northeasterly tradewinds.