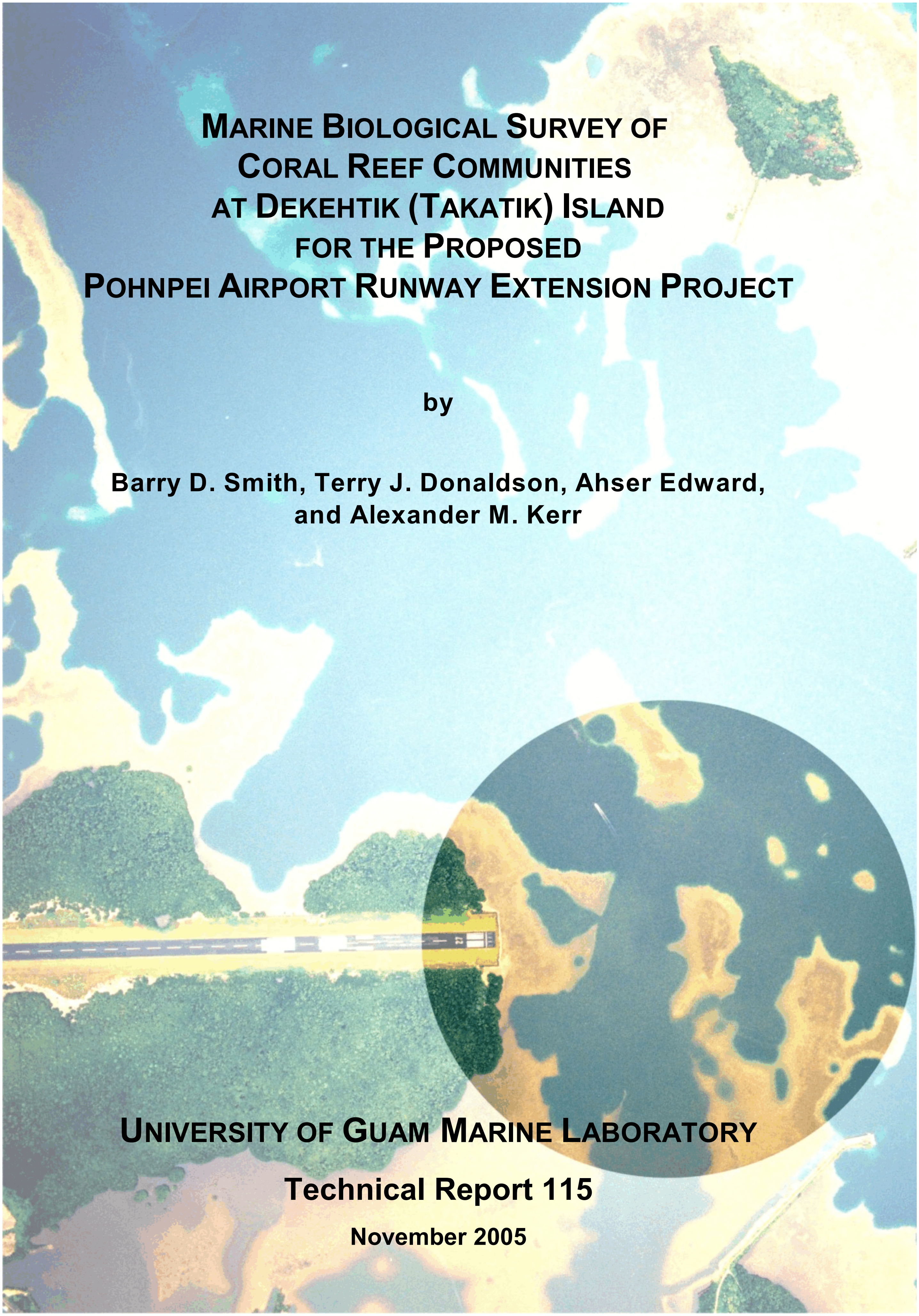


MARINE BIOLOGICAL SURVEY OF CORAL REEF COMMUNITIES AT DEKEHTIK (TAKATIK) ISLAND FOR THE PROPOSED POHNPEI AIRPORT RUNWAY EXTENSION PROJECT

by

Barry D. Smith, Terry J. Donaldson, Ahser Edward,
and Alexander M. Kerr

UNIVERSITY OF GUAM MARINE LABORATORY

Technical Report 115

November 2005

Marine Biological Survey of Coral Reef Communities at Dekehtik (Takatik) Island for the Proposed Pohnpei Airport Runway Extension Project

by

Barry D. Smith[1], Terry J. Donaldson[1], Ahser Edward[2], and Alexander M. Kerr[1]

[1]Marine Laboratory, University of Guam, UOG Station, Mangilao, GU 96923
[2]College of Micronesia-Federated States of Micronesia, Kolonia, Pohnpei, FM 96941

Final Report

Prepared for

Japan International Cooperation Agency

University of Guam Marine Laboratory

Technical Report 115

November 2005

Cover photo courtesy of Mr. Melson Darra, Airport Manager, Pohnpei International Airport.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

We are most grateful for the support and assistance provided by several organizations and individuals. We extend our thanks to Mr. Ieske Iehsi, General Manager of the Pohnpei Port Authority, for his logistical support and hospitality during this study. Mr. Melson Darra, Airport Manager of the Pohnpei International Airport, assisted us by providing aerial photographs that we used in performing this study. We thank Mr. James Arthur of The Village Hotel for accommodating our schedule with boats, scuba diving equipment, and his team of experienced boat operators, Mohner Edgar, Marson Filip, Jimmy Obispo, and Billy Remires. Coral photographs were taken by A.M. Kerr.

We are most grateful for the guidance and support provided by Mr. Tomotake Koha, Deputy Chief Engineer, Tokyo Regional Division, Nippon Koei Co., Ltd., and JICA Team Leader, and the entire JICA team for this project. We especially appreciate the efforts of Mr. Motohiro Hasegawa of the JICA team for acting as our liaison with JICA and the project team. This study was funded through a contract with the Japan International Cooperation Agency (JICA).

INTRODUCTION

The Japan International Cooperation Agency (JICA) is providing support and advice to residents and government officials of Pohnpei State, Federated States of Micronesia, as they consider a proposal to extend the runway at the Pohnpei International Airport and increase the payload capacity of aircraft using the airfield. Because the runway extends the entire length of Dekehtik Island, any increase in the length of the runway will require filling of the nearshore environment. To assess the status of coral communities and potential impacts of construction in the area under consideration for runway extension, the University of Guam Marine Laboratory was contracted to perform a study of marine communities in the proposed fill area and vicinity. A team of scientists from the Marine Laboratory conducted the survey in collaboration with a scientist colleague from the College of Micronesia-FSM from August 13–22, 2005. The data reported herein are intended to assist the residents and government officials of Pohnpei in making the best decision about their needs for development and environmental protection.

Scope of Work

The scope of work for this survey involved the following objectives:

(1) a review of the marine biological literature that includes the collection of existing data on distribution and ecological status of the coral within the study area and a general description on ecological status of the coral around the study area.

(2) a general field survey to provide the following information:

- (a) assessment of general ecological condition of the coral reef within the study site (approximately 200 ha, 1 km x 2 km) (Figure 1)
- (b) preparation of a general distribution map of corals with photographs of representative populations
- (c) general species composition of fish and invertebrates
- (d) area of coverage by coral reef

(3) a detailed field survey to provide the following information:

- (a) quantitative data on the species composition, distribution, and abundance of coral reef biota in the study site (approximately 14 ha, 200 m x 700 m) (Figure 1)

(b) area of coverage by coral reef

(c) assessment of the ecological condition of the coral reef

(d) quantitative assessment of the potential impact of airport development on the coral reef within the study area

SITE DESCRIPTION AND LITERATURE REVIEW

Site Description

Pohnpei, an island of about 365 km^2 in area, is located about 750 km from the Equator. The island is a volcanic high island surrounded by a barrier reef system with deep passes cutting through the reef at various intervals. Pohnpei is roughly circular with a radial pattern of rivers and streams draining from the highlands to the lagoon. The lagoon includes smaller high, rocky islands and low mangrove islands. The barrier reef complex includes fringing reefs that border both the main island and most of the smaller lagoon islands. Numerous patch reefs form a mosaic pattern in the lagoon, ranging in size from isolated pinnacles tens of meters in diameter to long ribbon-like ridges and intricately convoluted and branched reefs hundreds of meters in diameter and frequently enclosing secondary lagoons (Randall and Pendleton, 1980).

The present study encompasses the lagoon reefs at the eastern end of Dekehtik Island and outer Dausokele Channel (Figure 1). The airport runway presently extends across the entire east-west length of the Dekehtik Island. The proposed runway expansion will extend the airstrip at the east end of the island, affecting the reef communities in that area. The study consisted of two areas: a 200-ha rectangular area extending from about midway in the Dausokele Channel to about midway in the channel between Dekehtik and Lenger Islands; and a 14-ha rectangular area extending about 700 m east of Dekehtik Island (Figure 1).

The 200-ha study area included several habitat types. The Dausokele Channel, extending between the fringing reefs of the Net Point area of Pohnpei and Dekehtik Island, is an estuary with a fine mud floor. Beyond the Dausokele Channel, the study area encompasses patch reefs and lagoon floor (Figure 1).

The 14-ha study area covered a 200-m wide expanse of lagoon patch reef adjacent to Dekehtik Island (Figure 1). The 700-m eastern extent of the study area encompassed areas of the lagoon floor, a submerged coral knoll, and the patch reef immediately east of the fringing reef.

Literature Review

Authors of an environmental impact assessment for a prior proposal to extend the Pohnpei airstrip noted that much of the marine habitat around Dekehtik Island was disturbed

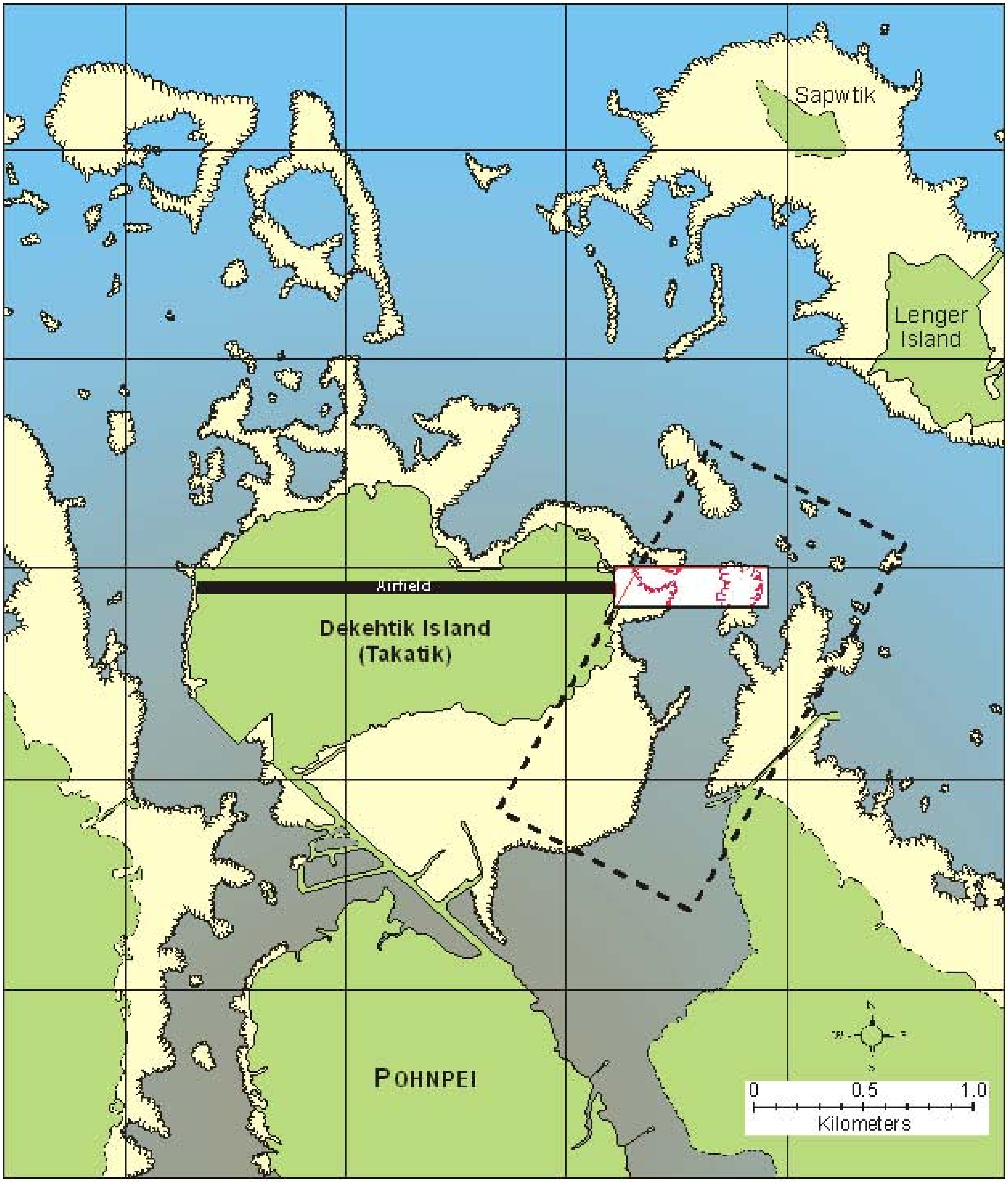


Figure 1. Map of Dekehtik Island showing the area of general survey (broken line) and the area of detailed survey (solid line). [Adapted from U.S. Geological Survey. 1983. Topographic Map of the Island of Ponape, Federated States of Micronesia. USGS, Denver, Colorado].

previously by dredging and land filling during the initial construction of the airfield (Trans Asia Engineering, 1977). Dredged areas were characterized in 1976 by the presence of steep to vertical lagoon slopes that exposed fresh lagoon reef and detrital deposits. Coral communities were poorly developed and in an early stage of recolonization at the time of the study. A thick, plastic layer of silt and mud covered the lagoon floor. The reef flat supported extensive seagrass meadows and a variety of fleshy and calcareous benthic algae, fishes, and invertebrates. Coral diversity, dominance, and colony size were greater in areas of the reef margin and reef slope that were undisturbed by dredging. Eighty-seven species of corals in 35 genera were observed on 8 transects in the study. The channel and lagoon slopes and margins and dredged slopes had a high diversity and high biomass of fishes, averaging 33 species per transect, of the total of 127 observed, and 6.6 fishes • m^{-1}. Nineteen species of benthic plants were recorded, with substrate coverage exceeding 30% on some transects. Twenty-six species of macroinvertebrates were reported, and it was noted that echinoids were absent from the transects (Trans Asia Engineering, 1977).

A limited current and biological study was completed in the Tuanmokot Channel by in 1974 (Tsuda et al., 1974). The purposes of the study were to report the ecological condition of Tuanmokot Channel, to assess potential effects of secondary effluent from a sewage outfall then under construction, and to recommend the most economical steps to improve ecological conditions in the channel. Tsuda et al. (1974) noted that the construction of the causeway connecting Takatik Island and Kolonia confined water flow from Tuanmokot Channel to three routes. The area around the outfall site was a considered depauperate environment because of excessive siltation. Forty-six species of corals 45 species of fishes, and 16 species of marine plants were recorded from transects in the channel. Coral cover was generally low (<1.0%), but locally high (41%). Algal cover was high (65%) on the reef platform because of the abundance of one species, *Halimeda opuntia*. The ichthyofauna of the outfall area was deemed impoverished, offering little either economically or aesthetically.

In 1976 the occurrence and natural habitat of the mangrove crab *Scylla serrata* were studied in Pohnpei (Dickinson, 1977). This study included a site in the southern entrance of a small channel that bisected Takatik Island prior to the construction of the airport runway. Although the water in the channel was brackish, Dickinson (1977) found no significant difference in temperature, salinity, and dissolved oxygen concentration in samples taken at the surface and near the bottom. Thirteen mangrove crabs were trapped, tagged, and released as part of a mark-recapture study; only one individual was recaptured, 25 days after release and some 200 m from the release location. Analysis of stomach contents indicated that mangrove crabs in Pohnpei fed primarily on the mud clam *Geloina coaxans* [= *Geloina papua*], but their diet included crustaceans, bits of vegetation, and fish.

Although reef habitat types, corals, marine plants, common macroinvertebrates, and fish eggs and larvae were surveyed in northern Pohnpei lagoon by Birkeland (1980), this study did not examine the reef communities adjacent to Takatik Island. However, current patterns in the lagoon immediately north of Takatik Island and exiting through Ponape Channel were studied (Pendleton, 1980). A significant relationship was found between wind direction and current direction near Ponape Channel, but no effect of tidal change was clearly demonstrated. Eldredge (1980) contributed a bibliography of coastal studies in Pohnpei.

The U.S. Army Corps of Engineers funded a coastal resource inventory in Pohnpei in 1984 (USACOE, 1986). This survey was qualitative in nature; species were reported in terms of relative abundance without delimiting categories such as abundant, common, and occasional. Dekehtik Island is situated within Section 5 (Palikir to Net) in this study. Coral communities on fringing reef flats in Dausokele Channel were described as depauperate because of limited water circulation and heavy terrestrial influences in a confined area. Coral cover was estimated generally to be <5.0% and often 0–2%. Coral communities on upper fringing reef slopes were reported to be particularly sparse in cover and diversity. Little, if any, coral was present on the sediment-dominated lagoon floor. Other taxa from the area were not specified, with the exception of a rabbitfish (Siganidae) spawning area on the northeast side of Dekehtik Island that was obliterated by the construction of the airstrip.

A second coastal resource survey was conducted in Pohnpei in 2005 as a joint effort of the Conservation Society of Pohnpei and The Nature Conservancy. The reef areas near Dekehtik Island were not surveyed during this study (W. Kostka, personal communication, July 2005).

METHODS

General Survey Area

The general ecological condition of an approximately 200 ha area (Figure 1) was assessed by a modified manta tow method. Two observers were towed by a boat piloted along the reef margin at selected sites within the study area. The general surface coverage of corals was estimated by the observers, and the species composition of corals, invertebrates, and fishes was noted by a recorder in the boat. Lengths of the tows were estimated from GPS data and from analysis of maps and aerial photographs. Area of coverage of coral reefs was calculated with SigmaScan Pro 5.0 (SPSS, Inc., 1999).

Detailed Survey Area

Physiographic Zonation

Zonation of reef communities extending eastwards from Dekehtik Island was determined along a transect line established from the shoreline to a distance of 700 m eastwards of the island. (Figure 1) Surface cover of the substrate at 10-m intervals along this transect was determined by sampling with a modified point-intercept method (Tsuda, 1972). A 25 x 25 cm quadrat frame, divided into a grid of 25 squares, each 5 x 5 cm, provided 16 interior "points" where the grid lines intersected. The quadrat was tossed randomly at 10-m intervals along the length of the transect, and substrate types or organisms under the points of intersection were tallied. Percent cover was calculated from these data. Depth was recorded at each 10-m interval.

Physiographic zones were defined upon the basis on the predominant features observed, including both biotic or abiotic components of the substrate. Corals, algae, macroinvertebrates, and fishes were then assessed along 100-m belt transects established perpendicular to the original transect line in each of the identified reef zones, except Transects 5 and 6. Transect 5 was a timed swim extending more than 100 m over the muddy lagoon floor. Transect 6 traversed the 30-m diameter of a small coral knoll encountered at 7.5 m depth.

Corals

Coral communities were quantitatively assessed along the 14 transects by an observer using the point-quarter method of Cottam et al. (1953). Points were assigned 10 m apart on each

100-m transect. Each point served as a focus of four equal-sized quadrants arrayed around the point. Within each quadrant, the coral closest to the central point was located. This coral's identity, distance from the point, length, and width were recorded. If no corals lay within 1 m of the point, that quadrant was recorded as having no corals. Corals that could not be identified in the field were photographed for later identification. From the recorded data, community and species-specific population density of colonies, percent coverage, and frequency of occurrence were then computed with the following equations from Cottam et al. (1953):

Total Density Of All Colonies = Unit Area / (Average Point-To-Colony Distance)^2
Percent Density Of A Species = 100 * Number Of Colonies Of The Species / Number Of All Colonies
Absolute Density Of A Species = Percent Density * Total Density / 100
Total Percent Coverage Of All Species = Total Density * Average Coverage Of All Species
Percent Coverage Of A Species = Species Density * Average Coverage of the Species

Dispersion data for each species were also calculated, including the number of colonies, average colony size, standard deviation of colony size, and minimum and maximum colony size. To record the less common species not recorded by the quantitative survey, a list of species was also assembled by swimming along the entire transects and recording all species seen within circa 2 m of the line. Species names followed Veron (2000), except where contradicted by Wallace (1999) for *Acropora* spp., in which case the latter author's taxonomy was used.

Marine Plants

Marine plants were quantified by randomly tossing a 25 cm x 25 cm gridded quadrat with 16 interior points (intersecting grid lines) twice for each 10-meter transect interval on a 100-meter transect line in each zone. The percent cover or abundance was calculated by dividing the number of points at which each species was recorded by the total number of points (16 points x number of tosses) and multiplying by 100 to arrive at the percent value. After recording the percent cover of algae from each 100-meter transect line, further observations were made in the area adjacent to the transect line to note the presence of other species of algae that did not occur within quadrats.

Macroinvertebrates

All conspicuous epibenthic macroinvertebrates occurring within 1 m of either side of the transect lines were identified and enumerated by an observer swimming along the transect line. For this study, conspicuous is defined as being larger than 15 mm in size and as being clearly visible to an observer without need of overturning rocks or digging into the substrate. Cryptic, microscopic, and nocturnal species were not included within the scope of this study.

Species diversity and abundance were recorded in 10-m intervals along the transect line. Therefore, for statistical purposes, each belt transect consisted of ten 20-m^2 replicate plots, except where noted. Similarities in structure of macroinvertebrate assemblages for all transects were calculated by the Bray-Curtis similarity method, and the resulting matrix subjected to cluster analysis (group average method, square root-transformed data) and multidimensional scaling (MDS) analysis (square root-transformed data bootstrapped with n = 100 iterations) to investigate relationships between transects. Cluster and MDS analyses were performed with PRIMER v5 (Clarke and Gorley, 2001). Species of macroinvertebrates observed in the study area, but not encountered along the transect line, were also recorded.

Fishes

Visual surveys were conducted by scuba diving and snorkeling along belt transects. Fishes were surveyed visually along 100-m transects established at 13 transects, a 30-m transect at one transect (Transect 6), and on a single, timed swim (Transect 5) at the detailed study area (n = 15 transects). The width of the transect varied with the body size and habitat utilization strategy of each species. Small-sized (less than 6 cm total length, TL), benthic-dwelling fishes that were usually cryptic were counted 1 m of either side of the transect line. Representative species included blennies (Blenniidae), gobies (Gobiidae), and triplefins (Tripterygiidae). All other species, regardless of size, were counted if they were observed within 2.5 m of either side of the transect line. Thus, the total area surveyed in a given transect was 200 m^2 and 500 m^2, respectively, except for Transect 6, where the areas surveyed were 60 m^2 and 150 m^2, respectively. Species seen in the area of each transect, but not observed on a transect, were also recorded to determine presence-absence of all species known from Pohnpei (Myers, 1999; unpublished checklist). All fishes were identified to species level. Taxonomic nomenclature followed Myers (1999) and Randall (2005), except that the parrotfishes, formerly the Scaridae, are now recognized as a subfamily (the Scarinae) of the wrasses (Labridae) (see review in Westneat and Alfaro, in press).

Data analyses included determinations of species richness (S), species diversity (H’), abundance, and density. In addition, similarities in fish assemblage structure for all transects were calculated (Bray-Curtis similarity method), and the resulting matrix submitted to cluster analysis (group average method, square root-transformed data) and multidimensional scaling (MDS) analysis (square root-transformed data bootstrapped with n = 100 iterations) to examine relationships between transects. Determinations of species richness, diversity, similarity, and cluster and MDS analyses were performed with PRIMER v5 (Clarke and Gorley, 2001).

RESULTS AND DISCUSSION

General Survey Area

Manta tow observations were completed over a total distance of 6,138 m along reef and channel margins in the general study area (Figure 2). Estimates of the total reef areas and perimeters of corals reefs surveyed in this study are provided in Table 1.

Live coral coverage on lagoon reefs D, E, and Nett Reef averaged 30–40%, with localized areas exceeding 50% coverage. Live coral cover on the eastern margin of Reef D was about 30%, but coverage dropped to less than 10% on the western side of this reef. The decline in coral cover may related to sedimentation, as silt-laden waters flowing out of Dausokele Channel pass between Dekehtik Island and the western side of Reef D (see Japan Airport Consultants, Inc., 2005). Coral communities on the eastern side Reef D were dominated by *Porites* cf. *australiensis*, with *Millepora* cf. *dichotoma* occurring at somewhat lower abundances. Scattered colonies of *Acropora* spp., *Diploastrea heliopora*, and *Turbinaria mesenterina* were also common. Coral communities on the western side of Reef D consisted entirely of small, scattered colonies of *Porites* cf. *australiensis* and *Porites rus*.

Table 1. Area of coverage by coral reef in the present study. Perimeter refers only to that part of the reefs within the rectangular study areas depicted in Figure 3. Only the total distance of the manta tows is provide for the channel margins.

	Perimeter (m)	Area (m^2)
General Study Area		
Patch Reef D	873	34,197
Patch Reef E	237	3,316
Fringing Reef, Nett Point	2,257	93,816
East Dausokele Channel Margin	1,082	n/a
West Dausokele Channel Margin	2,244	n/a
Detailed Study Area		
Reef Flat A (fringing reef)	976	33,811
Reef Flat B (patch reef)	783	30,067
Reef Flat C (fringing reef)	272	3,144

Live coral coverage on Reef E was about 40%, and communities consisted primarily of large colonies of *Millepora* cf. *dichotoma* and *Porites* cf. *australiensis*. *Porites rus* was less abundant, although still common. This reef also had scattered colonies of several *Acropora* spp. that were not encountered on belt transects on Reefs A, B, and C, e.g., *Acropora microclados*.

Nett Reef coral communities were most similar to the communities on the eastern side of Reef D, but with the addition of widely scattered colonies of *Seriatopora hystrix*. This species was not encountered elsewhere on reefs during the survey.

Live coral coverage in Dausokele Channel ranged from 0–1% on the channel margins near the Kolonia end of the study area to 20–30% on channel margins at the lagoon end of the channel. Few organisms of any kind inhabited the muddy channel floor near Kolonia. Scattered individuals of the anemone *Actinodendron glomeratum* and an unidentified sponge were the only conspicuous life that was observed. These organisms were gradually replaced by the calcareous algae *Halimeda opuntia* and the sponge *Haliclona* spp. over the next several hundred meters of the tows.

The first corals noted over the course of the manta tows from the Kolonia end towards the lagoon end were small colonies of *Porites* spp. The abundances and sizes of the colonies increased along the channel margin towards the lagoon as coverage increased from <1 % to about 30–40%. At the lagoon end of the channel margins, community composition of corals was similar to that for the reef margin of Reef A in the detailed portion of this survey.

Species of algae recorded from manta tows on the reef and channel margin were no different from the species recorded in the study area. Conspicuous macroinvertebrates were predominantly sponges, e.g., *Dysidea* cf. *herbacea*, over much of the channel margins.

Qualitative observations of fishes on manta tows were constrained by high turbidity. Most species (i.e., damselfishes, Pomacentridae; butterflyfishes, Chaetodontidae; snappers, Lutjanidae; surgeonfishes, Acanthuridae, etc.) were observed in habitats with good coral development. Reefs D and E, Net Reef, and the East Channel Margin had considerably greater numbers of fish species present, most of which were associated with coral heads or some form of structure. Commonly observed species included the parrotfish *Chlorurus sordidus* (Labridae: Scarinae), the surgeonfishes *Ctenochaetus striatus* and *Acanthurus nigrofuscus* (Acanthuridae), the damselfish *Chrysiptera cyanea*, the butterflyfish *Chaetodon lunulata* (Chaetodontidae), the

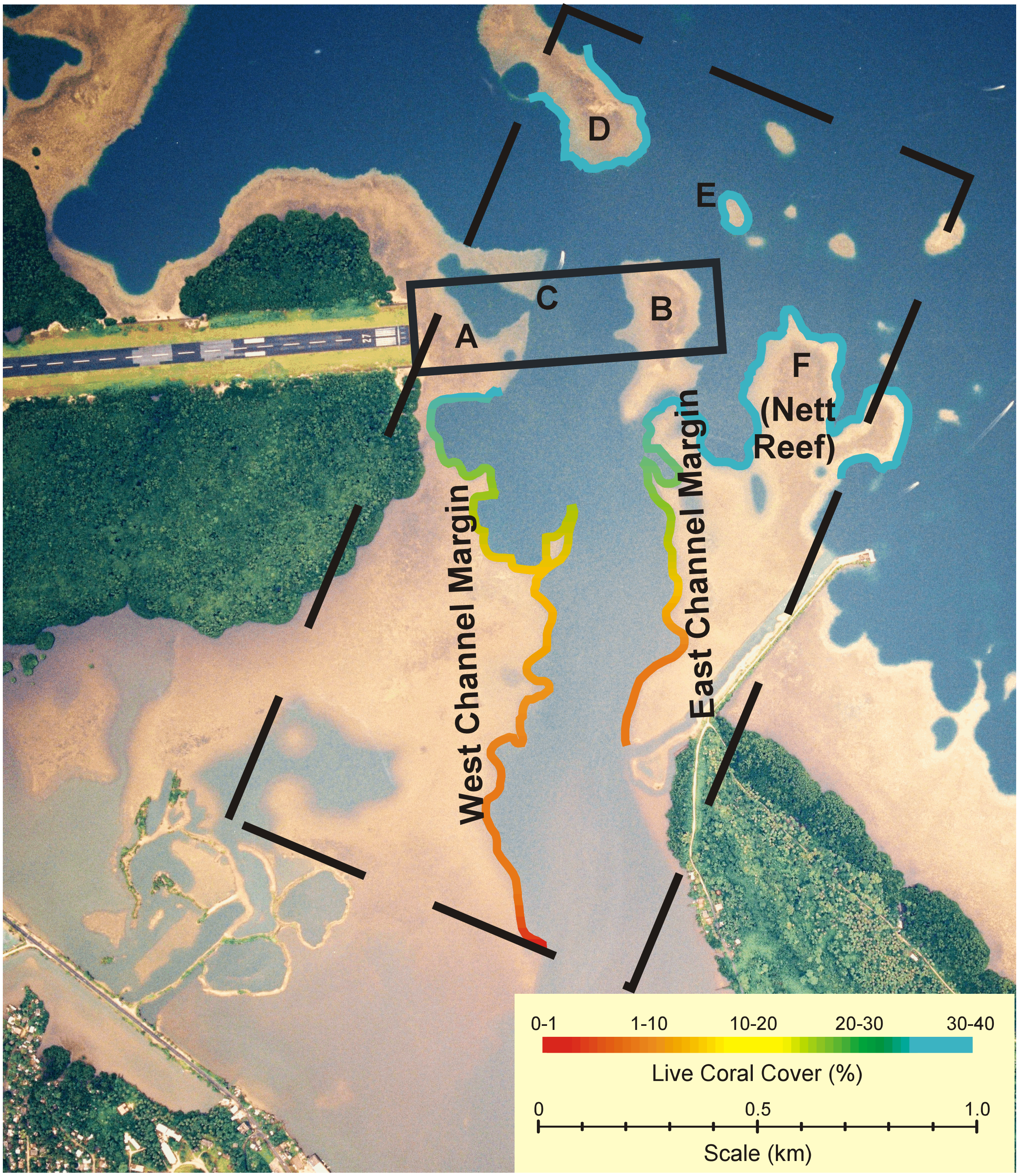


Figure 2. Aerial photograph of the eastern end of Dekehtik Island, Nett Point, and Dausokele Channel, showing the distribution of reefs studied by transects (A, B, and C) and by manta tows (D, E, F, and Dausokele Channel). Reefs and channel margins surveyed by manta tows are indicated by colored lines. Percent live coral cover is indicated by the color of the manta tow line.

wrasse *Thalassoma amblycephalum* (Labridae), and the cardinalfishes *Zoramia leptacantha* and *Rhabdamia cypselurus* (Apogonidae).

Some species of fishes (e.g., *Chrysiptera cyanea*, Pomacentridae) were seen commonly, even in turbid waters, on silt or mud flats containing boulders or some other form of structural refuge. The West Channel Margin was the most depauperate area examined, with only two species of fished noted. The damselfish *Chrysiptera cyanea* (Pomacentridae) was observed near small rocks and boulders, and the burrowing shrimp goby *Cryptocentrus strigillicep*s (Gobiidae) was relatively abundant near small rocks or on rubble.

DETAILED SURVEY AREA

Physiographic Zonation

Percent surface coverage of the substrate by ten abiotic and biotic features along a transect extending 700 m eastwards from the shoreline of Dekehtik Island is presented in Table 2 and Figure 3. The lagoon floor from 410 m to 500 m was not sampled. The depth in that portion of the transect exceeded 25 m, and we observed that the lagoon floor at depths greater than 11 m throughout the area was covered by a fine mud similar to that described as “settled muddy marine snow” by Wolanski et al. (2003). A profile of the reef along the transect is given in Figure 4.

Based on these data, fourteen physiographic zones were identified for detailed study of the reef biota (Table 3, Figure 4). With the exception of two of the physiographic zones, 100-m belt transects were established perpendicular to the original transect for investigation of the corals, marine plants, invertebrates and fishes. The lagoon floor zone was surveyed during a timed swim, and a coral knoll encountered at 7.5 m depth was 30 m in diameter. An additional 100-m transect was established at 9.5 m on the reef slope north of the 700-m transect (Figure 5). Locations of all belt transects are shown in Figure 5.

Corals

The complete list of species recorded from eastern Dekehtik Island is given in Table 4. Eighty species of scleractinian corals in 40 genera and 16 families were seen in and near the fifteen transects. An additional five species of non-scleractinian stony corals in four genera and three other orders of anthozoans were also recorded. Hence, a total of 85 species of stony corals

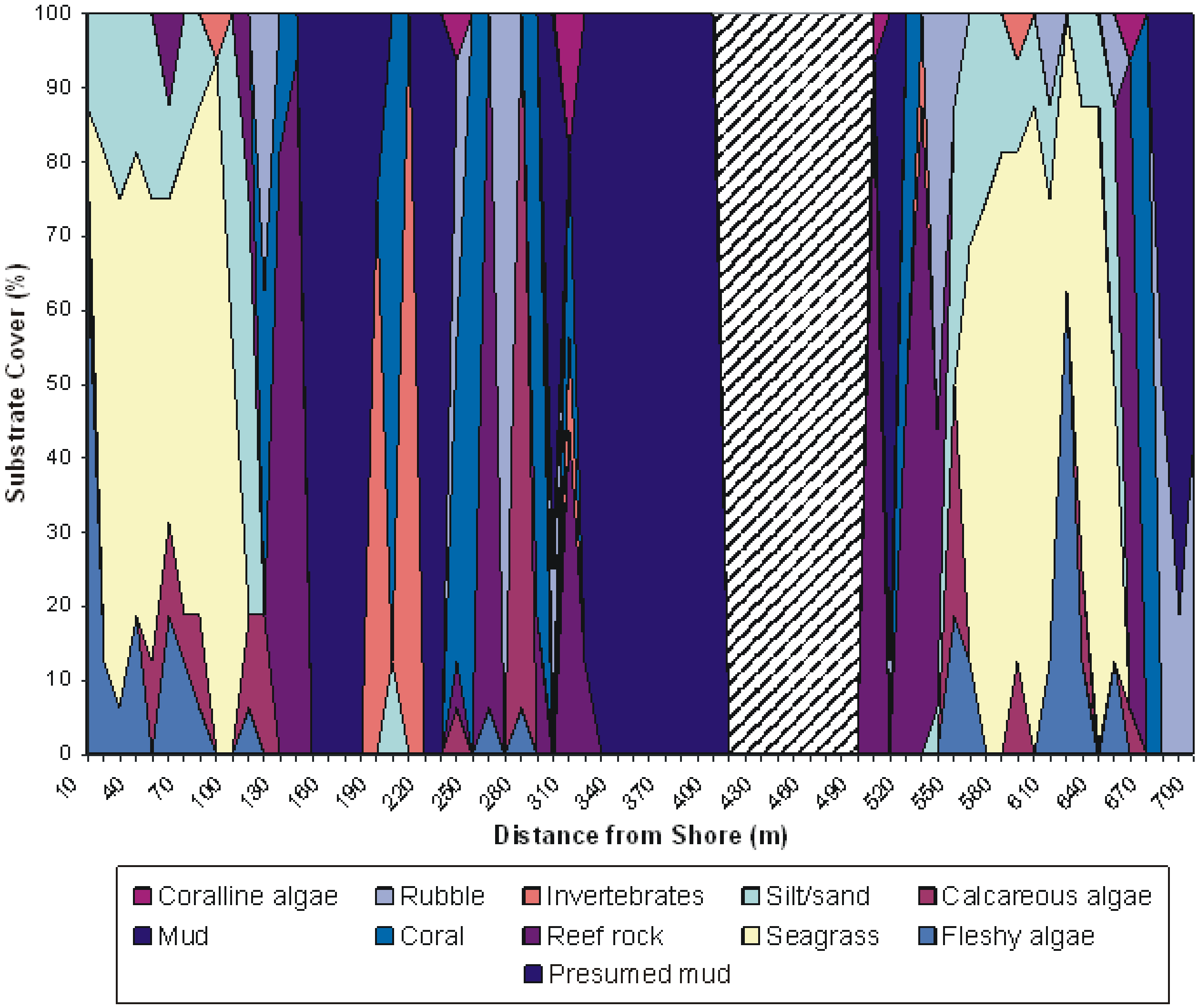


Figure 3. Percent surface coverage by ten abiotic and biotic features along a 700-m transect extending eastwards from the shoreline of Dekehtik Island, Pohnpei. The lagoon floor from 410 m to 500 m was presumed to be mud.

was seen at the study site. This count represents a minimum, because several corals could only be identified to genus and, therefore, may consist of more than one species. By comparison, in a previous study done on the western side of Dekehtik Island, Tsuda et al. (1974) found only 46 species of corals. A later study of the eastern side of Dekehtik, that included a larger study area and more diverse habitats (Trans Asia Engineering, 1977), reported a total of 87 species around eastern Dekehtik reefs and nearby areas. These latter authors asserted that a thorough investigation of the area and nearby habitats, presumably including the likely much more diverse

Table 2. Percent surface coverage by predominant abiotic and biotic features along a 700-m transect extending eastwards from the shoreline of Dekehtik Island, Pohnpei.

Distance from shore (m)	Fleshy algae	Calcareous algae	Seagrass	Silt/sand	Reef rock	Invertebrates	Coral	Rubble	Mud	Coralline algae
10	68.75	6.25	12.5	12.5	0	0	0	0	0	0
20	12.5	0	68.75	18.75	0	0	0	0	0	0
30	6.25	0	68.75	25	0	0	0	0	0	0
40	18.75	0	62.5	18.75	0	0	0	0	0	0
50	0	12.5	62.5	25	0	0	0	0	0	0
60	18.75	12.5	43.75	12.5	12.5	0	0	0	0	0
70	12.5	6.25	62.5	18.75	0	0	0	0	0	0
80	6.25	12.5	68.75	12.5	0	0	0	0	0	0
90	0	0	93.75	0	0	6.25	0	0	0	0
100	0	0	56.25	43.75	0	0	0	0	0	0
110	6.25	12.5	0	56.25	25	0	0	0	0	0
120	0	18.75	0	0	0	0	43.75	37.5	0	0
130	0	0	0	0	81.25	0	18.75	0	0	0
140	0	0	0	0	93.75	0	6.25	0	0	0
150	0	0	0	0	0	0	0	0	100	0
160	0	0	0	0	0	0	0	0	100	0
170	0	0	0	0	0	0	0	0	100	0
180	0	0	0	0	0	0	0	0	100	0
190	0	0	0	0	0	75	0	0	25	0
200	0	0	0	12.5	0	0	87.5	0	0	0
210	0	0	0	0	0	100	0	0	0	0
220	0	0	0	0	0	0	0	0	100	0
230	0	0	0	0	0	0	0	0	100	0
240	0	6.25	0	0	6.25	0	43.75	37.5	0	6.25
250	0	0	0	0	0	0	100	0	0	0
260	6.25	0	0	0	93.75	0	0	0	0	0
270	0	0	0	0	0	0	0	100	0	0
280	6.25	93.75	0	0	0	0	0	0	0	0
290	0	0	0	0	18.75	0	81.25	0	0	0
300	0	0	0	0	0	0	0	25	75	0
310	0	0	0	0	43.75	12.5	25	0	0	18.75

Table 2. Continued.

Distance from shore (m)	Fleshy algae	Calcareous algae	Seagrass	Silt/sand	Reef rock	Invertebrates	Coral	Rubble	Mud	Coralline algae
320	0	0	0	0	12.5	0	0	0	87.5	0
330	0	0	0	0	0	0	0	0	100	0
340	0	0	0	0	0	0	0	0	100	0
350	0	0	0	0	0	0	0	0	100	0
360	0	0	0	0	0	0	0	0	100	0
370	0	0	0	0	0	0	0	0	100	0
380	0	0	0	0	0	0	0	0	100	0
390	0	0	0	0	0	0	0	0	100	0
400	0	0	0	0	0	0	0	0	100	0
410										
420										
430										
440										
450										
460										
470										
480										
490										
500	0	0	0	0	87.5	6.25	0	0	0	6.25
510	0	0	0	0	0	0	0	12.5	87.5	0
520	0	0	0	0	50	0	50	0	0	0
530	0	0	0	0	87.5	12.5	0	0	0	0
540	0	0	0	6.25	37.5	0	0	56.25	0	0
550	18.75	31.25	0	37.5	0	0	0	12.5	0	0
560	12.5	0	56.25	31.25	0	0	0	0	0	0
570	0	0	75	25	0	0	0	0	0	0
580	0	0	81.25	18.75	0	0	0	0	0	0
590	0	12.5	68.75	12.5	0	6.25	0	0	0	0
600	0	0	87.5	12.5	0	0	0	0	0	0
610	12.5	0	62.5	12.5	0	0	0	12.5	0	0
620	62.5	0	37.5	0	0	0	0	0	0	0
630	12.5	12.5	62.5	12.5	0	0	0	0	0	0

Table 2. Continued.

Distance from shore (m)	Fleshy algae	Calcareous algae	Seagrass	Silt/sand	Reef rock	Invertebrates	Coral	Rubble	Mud	Coralline algae
640	0	0	87.5	12.5	0	0	0	0	0	0
650	12.5	0	37.5	37.5	0	0	0	12.5	0	0
660	0	6.25	0	0	87.5	0	0	0	0	6.25
670	0	0	0	0	0	0	100	0	0	0
680	0	0	0	0	0	0	0	50	50	0
690	0	0	0	0	0	0	0	18.75	81.25	0
700	0	0	0	0	0	0	0	43.75	56.25	0

Table 3. Delineation of physiographic zones by distance from Dekehtik Island, depth, and transect number.

Transect No.	Physiographic Zone (m)	Range from Shore (m)	Depth Range (m)
Fringing Reef Zones			
1	Reef flat	0–90	0–0.3
2	Transition zone	95–105	0.3
3	Reef margin	110–115	0.3–0.6
4	Reef slope	120–140	0.6–6.1
5	Lagoon floor	150–180	10.6–12.2
6	Coral knoll	195–210	7.6–9.5
7	Reef slope	240–250	0.6–4.6
8	Reef flat	260–280	0.9
9	Reef margin	280–290	0.6–0.9
Lagoon Patch Reef Zones			
10	Reef slope	290–310	0.6–7.3
11	Reef margin	530–540	0.6
12	Reef flat	550–650	0.3
13	Reef margin	650–660	0.3–0.6
14	Reef slope	660–680	0.6–8.5
15	Reef slope	NA	8–9

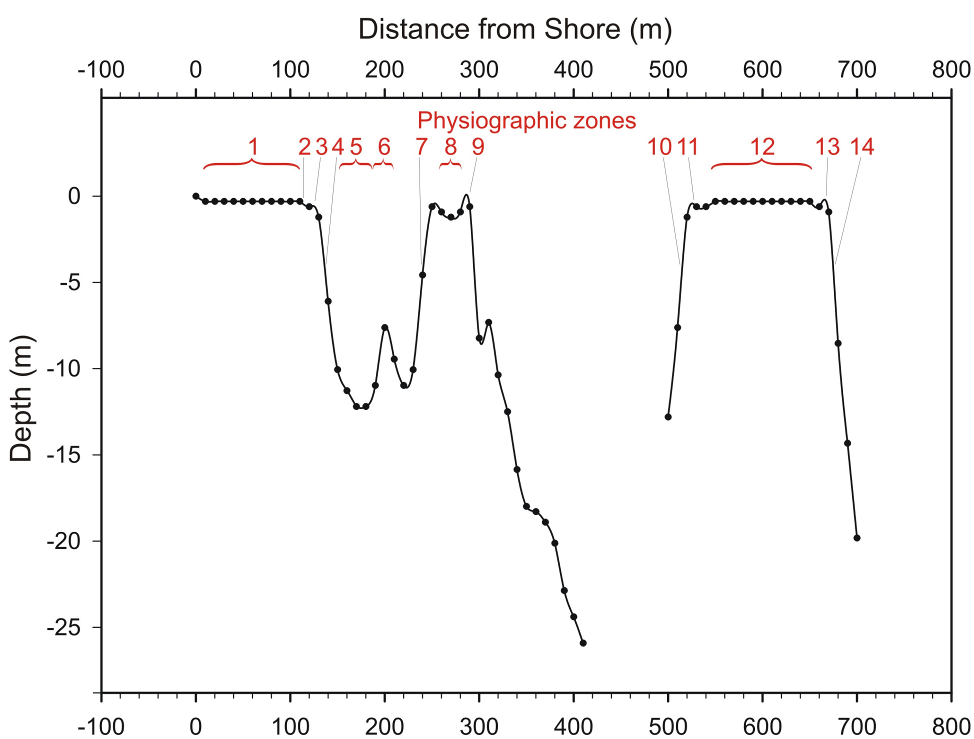


Figure 4. Reef profile along a 700-m transect extending eastwards from the airport runway at Dekehtik Island, Pohnpei. Locations of 14 physiographic zones are shown in red.

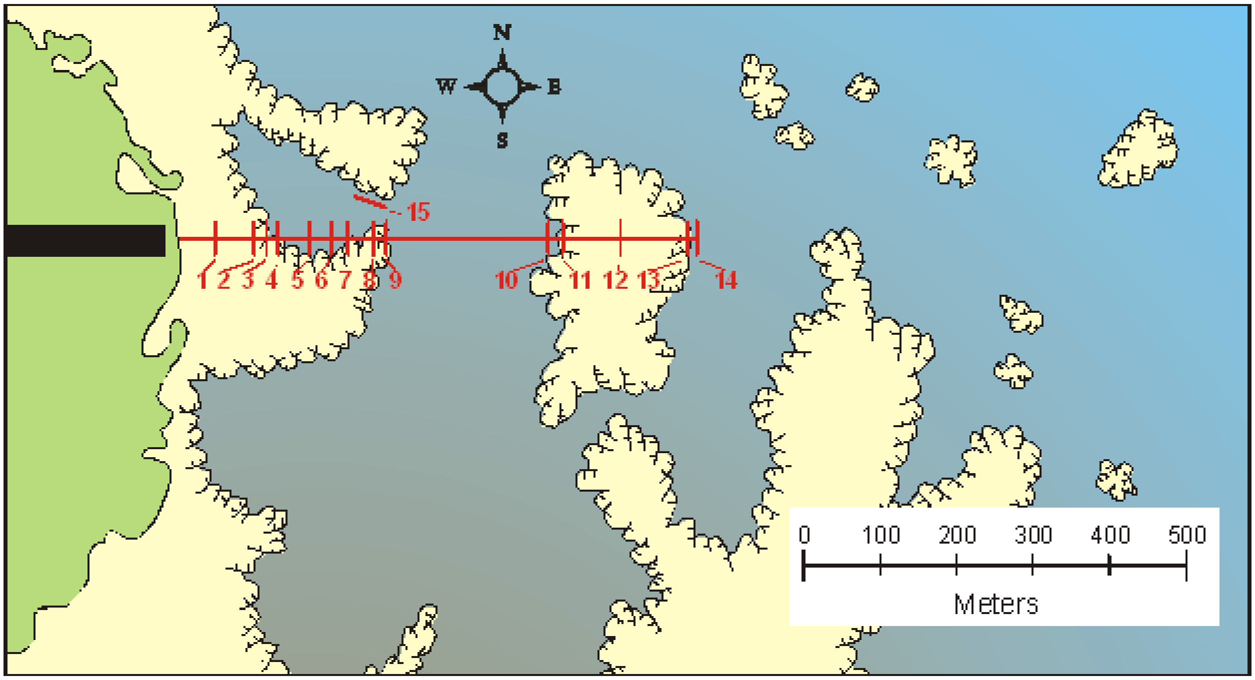


Figure 5. Map of eastern Dekehtik Island slowing locations of 15 belt transects established in the proposed airport runway extension area.

outer lagoon and slope, would uncover about 250 species of corals. This number is reasonable given the biogeography of corals in the western Indo-Pacific region (Veron, 2000).

Table 5 summarizes the transect data by species. The most common corals on most of the transects were massive *Porites* spp. Field identification of the species involved was difficult, but based on the previous survey by Trans Asia Engineering (1977), undoubtedly consisted mostly of *Porites australiensis* and, to a much lesser extent, *Porites lutea*. These colonies were sometimes nearly 2 m in diameter. The digitate acroporid *Montipora digitata* was also quite common, sometimes forming extensive stands in shallow water at the margin between the reef flats and channel slopes. Growing alongside the *Montipora* were other digitate or columnar species of *Porites*: *Porites cylindrica* and *Porites rus*. The encrusting coral *Leptastrea purpurea* was also fairly common, although as scattered small and semi-cryptic colonies. Corals in the genus *Acropora* comprise 25% of extant reef species worldwide and tend to dominate in terms of areal coverage and number of colonies on many coral reefs. However, while this genus

Table 4. Checklist of corals from eastern Dekehtik Island. O = greater than 2 m off the transect.

	Transect															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
ACROPORIDAE																
Acropora acuminata																X
Acropora aspera			X	X				X		X	X		X		X	
Acropora caroliniana																X
Acropora clathrata																X
Acropora cytherea																X
Acropora echinata				X			X			X						
Acropora latistella													X			
Acropora muricata																X
Acropora nasuta			X										X	X		
Acropora tenuis													X			
Acropora sp. 1										X						
Acropora sp. 2										X						
Acropora sp. 3														X		
Acropora sp. 4																X
Acropora sp. 5																X
Acropora sp. 6																X
Acropora sp(p).																X
Astreopora myriophthalma										X						
Montipora digitata		X	X	X				X	X	X	X		X	X		
Montipora turgescens														X		
Montipora verrucosa				X		X				X						
Montipora sp. 1									X						X	
AGARICIIDAE																
Pavona cactus														X		
Pavona decussata				X			X							X		
Pavona varians														X		
Pachyseris rugosa			X			X	X			X	X		X	X		

Table 4. Continued.

	Transect															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
Pachyseris speciosa			X	X		X	X			X	X		X	X	X	
Gardineroseris planulata										X	X					
ASTROCOENIIDAE																
Stylocoeniella armata				X												
DENDROPHYLLIIDAE																
Turbinaria reniformis							X			X						
Tubastrea micrantha							X									
EUPHYLLIIDAE																
Euphyllia glabrescens															X	X
Euphyllia paraancora						X	X			X						
Plerogyra sinuosa																X
Physogyra lichtensteini							X			X					X	
FAVIIDAE																
Diploastrea heliopora			X	X		X				X			X	X	X	
Favia matthai				X		X	X			X	X		X	X	X	
Favia pallida				X						X						
Favites complanata						X								X		
Goniastrea pectinata				X		X				X	X			X	X	
Leptastrea purpurea		X	X	X		X	X	X	X	X	X			X	X	
Montastrea curta																X
Platygyra daedalea											X					
Platygyra lamellina														X		
Platygyra pini			X							X	X					
FUNGIIDAE																
Ctenactis crassa							X									
Cycloseris sp														X		
Fungia fungites															X	X

Table 4. Continued.

	Transect															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
Fungia repanda																X
Fungia pautomensis						X	X				X					
Fungia scutaria																X
Herpolitha limax						X					X					
Lithophyllon mokai							X							X	X	
Polyphyllia novaehiberniae											X					
Polyphyllia talpina				X			X									
Zoopilus echinatus										X						
Unidentified fungiid(s)						X					X		X			
MERULINIDAE																
Hydnophora microconus																X
Paraclavarina triangularis						X	X			X					X	
MUSSIDAE																
Lobophyllia hemprichii			X	X		X	X			X				X	X	
Symphyllia agaricia											X					
Symphyllia radians			X													
OCULINIDAE																
Galaxea fascicularis										X	X			X		
Galaxea horrescens				X									X	X		
PECTINIDAE																
Echinophyllia aspera						X	X			X						
Mycedium elephantotus																X
Pectinia alcicornis				X		X	X			X				X	X	
POCILLIPORIDAE																
Pocillopora damicornis		X	X	X			X		X	X	X		X	X	X	
Seriatophora hystrix																X

Table 4. Continued.

	Transect															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
PORITIDAE																
Goniopora columna														X		X
Goniopora sp(p).						X	X			X				X	X	
Porites australiensis		X	X	X		X	X	X	X	X	X		X	X	X	
Porites cylindrica				X						X			X	X	X	
Porites rus			X	X		X			X	X			X	X	X	
SIDERASTREIDAE																
Coscinaraea sp.			X													
Psammocora contigua		X	X						X		X		X			
Psammocora digitata		X	X					X			X					
Psammocora obtusangula																X
Psammocora sp.															X	X
HELIOPORACEA																
Heliopora coerulea																X
MILLIPORIINA																
Millepora dichotoma							X			X						
Millepora platyphylla							X									
STYLASTERINA																
Stylaster sp(p).																X
Distichopora sp(p).																X

consisted of 17 species, or 22% of the species encountered at Dekehtik, they often occurred only as small singletons and contributed negligibly in terms of community cover and colonies. This may be due to the silty habitats at Dekehtik. Many of the *Acropora* seen are species that are common elsewhere in Micronesia and, likewise, probably dominate in less turbid habitats around Pohnpei. Hence, the *Acropora* species seen at Dekehtik may form an assemblage that is maintained largely by recruitment from communities outside the study area.

In contrast to the poor representation by *Acropora*, several genera of corals specializing in turbid environments were quite common at Dekehtik. Species in genera such as *Turbinaria*, *Pachyseris*, *Echinophyllia* and *Pectinia*, plus species of Euphylliidae and Fungiidae, favor back reef and lagoonal environments. These species were often seen on the lower slopes, and sometimes formed extensive stands there. Such species are much less common in clear, open waters of the outer reef slopes outside of lagoons. As such, fungiid corals were especially diverse; we recorded a total of 12 species from 8 genera. Multiple genera were often found living side-by-side, presumably a result of similar microhabitat preferences.

Several corals had interesting distributions within the study area. *Stylocoeniella armata* was seen as a single individual colony. This species normally forms small colonies on the sides of rubble or near the openings of crevices. Four species of *Psammocora* were seen. The most common species, *Psammocora contigua*, formed small stands near the reef margins amongst the more common species of *Porites* and *Montipora*. These and other margin species are columnar or digitate and hence commonly reproduce asexually by fragmentation of their easily broken branches. *Pocillopora damicornis* was another relatively common species in the study area. In many places, it is most common on the reef flat, where it forms small round colonies of stubby branches. However, at Dekehtik, it was most common on the lower slope. In such environments, the species forms small, flat tables of fine branches. Another species from the same family, *Seriatopora hystrix*, was only seen widely scattered around the reef near Nett Point. This odd distribution, concentrated on one reef, suggests that the population is locally maintained. Further, the large distances between colonies may indicate that the population is maintained sexually.

Table 5. Population density and coverage of coral species recorded on the transects. N = number of colonies. Mean, SD (standard deviation) and Range refer to colony coverage in cm^2.

Transect	Habitat	Species	N	Mean	SD	Range
Transect 1	Reef Flat	No Corals	0			
Transect 2	Transition	*Leptastrea purpurea*	1	126		126–126
		Montipora digitata	3	38	35	16–79
		Pocillopora damicornis	1	207		207–207
		Porites spp.	20	362	323	7–1253
Transect 3	Reef Margin	*Leptastrea purpurea*	3	90	98	19–201
		Lobophyllia hemprichii	1	181		181–181
		Pachyseris speciosa	1	726		726–726
		Porites spp.	34	1499	1670	71–8553
		Psammocora contigua	1	1103		1103–1103
Transect 4	Reef Slope	*Diploastrea heliopora*	1	511		511–511
		Goniastrea pectinata	1	154		154–154
		Lobophyllia hemprichii	1	641		641–641
		Porites rus	5	1165	1285	2–2827
		Porites spp.	29	897	1019	16–4700
		Stylocoeniella armata	1	1253		1253–1253
Transect 5	Lagoon Floor	No Corals	0			
Transect 6	Coral Knoll	*Euphyllia paraancora*	1	60		60–60
		Goniastrea pectinata	1	25		25–25
		Goniopora sp.	1	49		49–49
		Pectinia alcicornis	1	735		735–735
		Porites rus	3	62	82	14–157
Transect 7	Reef Slope	*Echinophyllia elephantotus*	2	118	47	85–151
		Goniopora sp.	1	173		173–173
		Lithophyllon mokai	1	24		24–24
		Pachyseris speciosa	1	9		9–9
		Paraclavina triangularis	4	594	909	11–1930
		Pectinia alcicornis	2	107	129	16–198
		Turbinaria reniformis	1	113		113–113
Transect 8	Reef Flat	*Acropora aspera*	2	26	18	13–38
		Leptastrea purpurea	3	538	894	16–1571
		Montipora digitata	3	108	61	38–143
		Porites spp.	22	802	2454	9–11663
		Psammocora digitata	1	2664		2664–2664

Table 5. Continued.

Transect	Habitat	Species	N	Mean	SD	Range
Transect 9	Reef Margin	*Leptastrea purpurea*	1	13		13–13
		Montipora digitata	1	9		9–9
		Montipora sp.	1	3574		3574–3574
		Pocillopora damicornis	1	110		110–110
		Porites rus	1	2224		2224–2224
		Porites spp.	34	1835	2597	50–10838
		Psammocora contigua	1	302		302–302
Transect 10	Reef Slope	*Acropora echinata*	1	38		38–38
		Acropora spp.	3	106	89	3–160
		Diploastrea heliopora	2	2604	804	2036–3173
		Galaxea fascicularis	1	50		50–50
		Goniopora sp.	1	5		5–5
		Pectinia alcicornis	3	30	15	13–39
		Porites rus	12	349	517	13–1571
		Porites spp.	15	476	551	33–1838
Transect 11	Reef Margin	*Leptastrea purpurea*	1	145		145–145
		Platygyra daedalea	1	24		24–24
		Platygyra pini	1	7		7–7
		Porites spp.	37	610	615	55–2523
Transect 12	Reef Flat	No Corals	0			
Transect 13	Reef Margin	*Montipora digitata*	2	221	242	50–393
		Pachyseris speciosa	1	24		24–24
		Porites cylindrica	1	813		813–813
		Porites rus	2	209	145	106–311
		Porites spp.	34	2091	5079	66–28652
Transect 14	Reef Slope	*Cycloseris* sp.	2	31	3	28–33
		Galaxea fascicularis	1	8		8–8
		Goniastrea pectinata	2	31	27	13–50
		Goniopora sp.	1	50		50–50
		Lobophyllia hemprichii	1	94		94–94
		Montipora digitata	1	78		78–78
		Pachyseris speciosa	1	1		1–1
		Pavona varians	1	19		19–19
		Platygyra pini	1	16		16–16
		Porites rus	4	613	1019	24–2132
		Porites spp.	18	161	194	1–754

Table 5. Continued.

Transect	Habitat	Species	N	Mean	SD	Range
Transect 15	Reef Slope	*Diploastrea heliopora*	1	53		434–434
		Euphyllia glabrescens	1	11		94–94
		Favia mathaii	2	73	74	188–412
		Fungia fungites	1	10		85–85
		Goniopora sp	1	3		28–28
		Leptastrea purpurea	1	36		297–297
		Lobophyllia hemprichii	1	21		174–174
		Pachyseris speciosa	1	98		803–803
		Paraclavarina triangularis	2	13	17	6–104
		Pectinia alcicornis	1	3		24–24
		Pocillopora damicornis	4	131	187	11–452
		Porites cylindrica	3	250	609	31–1237
		Porites rus	8	865	1269	57–3676
		Porites sp	9	2780	3999	110–12951
		Psammocora sp	1	98		357–357

Table 6 summarizes the transect data. There was considerable variation in the species richness, coverage, and population density of the corals from one transect to another. This variation was largely due to the stark differences in habitat comprising the areas in which the transects were placed. Two transects, those done on the seagrass-dominated reef flats, had no corals either on or off the transects. Much of the area in these habitats became subaerially exposed during low tides and hence are presumably unable to support large corals. The complete lack of even small colonies may indicate that the flats experience high temperatures from diurnal spring low tides or that the flats are periodically flushed by freshwater discharge from the rivers, perhaps after large storms. The most diverse transects were those from the slopes. For example, Transect 10 was the most diverse, with 30 species in 23 genera from 13 families. This compares with the 29 species found in a nearby area surveyed by Trans Asia Engineering (1977). The next most diverse transect, also done on the slope, had at total of 27 species in 18 genera from 9

Table 6. Summary of transect data for corals.

Transect	Habitat	Total Species	Total Genera	Total Families	Density (N/100 m^2)	Percent Coverage
1	Reef flat	0	0	0	0	0
2	Transition	5	4	4	1.64	3.14
3	Reef margin	16	12	8	14.74	19.27
4	Reef slope	20	15	10	3.76	32.32
5	Lagoon floor	0	0	0	0	0
6	Coral knoll	19	17	9	2	1.76
7	Reef slope	23	20	13	1.22	0.96
8	Reef flat	5	5	4	3.89	21.65
9	Reef margin	7	5	5	14.87	25.09
10	Reef slope	30	23	13	5.99	25.51
11	Reef margin	20	17	9	8.14	46.27
12	Reef flat	0	0	0	0	0
13	Reef margin	16	10	8	11.33	20.15
14	Reef slope	27	18	9	2.02	2.9
15	Reef slope	20	17	10	4.9	43.9

families (Table 6). Next to subaerial exposure during low tides, the next most important determinant of coral community diversity appeared to be substrate composition.

Much of the lower slopes and channel bottoms consist of fine-grain sediments unsuitable for settlement by the planula larvae of corals. This may also account for the lower diversity and coverage of corals seen during qualitative assessment of reef margins closer to the river mouth. There, even hard substrates were coated in silt, and visibility was quite limited because of suspended sediment. In these areas, sponges and ascidians dominated the bottom. By contrast, the channel bottoms investigated even farthest from the river consisted of fine, unconsolidated sediments, silts, and muds. There, visibility was near zero, and no corals occurred. The area of coverage by coral reefs and their associated communities totaled some 48% of the 14 ha in detailed study area (Table 1).

Marine Plants

A total of 26 species representing 21 genera of marine plants was observed in the study area east of the Dekehtik runway (Table 7). This number is about half of the number recorded from the studies in the lagoons of Chuuk, Yap, and Pohnpei (Amesbury et. al., 1977a, 1977b; Birkeland, 1980). The Dausokele River, the second largest river in Pohnpei, drains into the estuary in which the study area is located. Sediments and freshwater from the Dausokele watershed contribute to the high turbidity in the study area, and this may serve to explain the low diversity of algae observed. None of the species recorded was considered to be rare or endangered.

Figure 6 shows the α diversity of marine algae found in each of the general physiographic zones. Species diversity generally declined with depth, with the greatest species diversity found on the reef flat. The reef flat immediately adjacent to the shoreline had a higher number of algae (Transect 1) as compared to the farthest reef flat (Transect 12).

The highest diversity among marine algal groups was exhibited by the Chlorophyta followed by the Phaeophyta. The least diverse group was the Cyanophyta, with only two species observed. *Microcoleus lyngbyaceus* was recorded on 6 of the 14 transects, and *Schizothrix calcicola* was recorded in three.

The highest percent surface cover recorded for an individual species was 18.8% for *Gracilaria edulis* on Transect 12, despite the low frequency of this species, which occurred on only 2 of the 14 transects (Table 8). Two species of Chlorophyta, *Halimeda microphysa* and *Halimeda opuntia*, occurred on 9 of the 14 transects, and *Neomeris annulata* was observed on 8. On Transect 4, *Halimeda microphysa* accounted for 14.7 % surface cover on the reef slope. *Halimeda microphysa* was also observed at moderately high percentages on the reef margins dominated by *Porite*s corals. Although *Halimeda opuntia* was recorded with the highest frequency on the transects (Table 7), its coverage was low. The highest percent cover for *Halimeda opuntia* was 4.69%.

All the species of seagrasses reported from Pohnpei were present at the study site. *Thallasia hemprichii* dominated the reef flat adjacent to the shoreline (Transect 1), and the newly reported *Cymodocea rotundata* (McDermid and Edward, 1999) dominated the reef flat farthest

Table 7. Checklist of marine plants recorded from 15 transects within the proposed extension area of the Dekehtik runway, Kolonia, Pohnpei Federated States of Micronesia, 14–21 August 2005.

	Transect														
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chlorophyta															
Boodlea composita (Harv.) Brand	x									x	x				
Caulerpa serrulata (Forsk.) J. Ag.									x						
Caulerpa sertularioides (West) C. Ag.		x													
Chlorodesmis fastigiata Harvey								x			x		x		
Halimeda macroloba Decaisne		x	x				x		x					x	
Halimeda macrophysa Askenasy	x		x	x		x		x	x	x			x	x	x
Halimeda cylindracea Decaisne											x		x		
Halimeda opuntia (L.) Lamx.	x	x	x				x	x		x	x	x	x		
Neomeris annulata Dickie	x	x		x			x			x	x	x		x	x
Tydemannia expeditionis W. V. Bosse													x		
Valonia ventricosa J. Agardh													x		
Cyanophyta															
Microcoleus lyngbyaceus (Kutz. Crouan)	x	x	x	x						x		x			
Schizothrix calcicola (Ag.) Gomont						x					x			x	x
Phaeophyta															
Dictyota bartayresii Lamx.		x				x				x				x	x
Dictyota cervicornis Kutz		x								x	x		x		
Ectocarpus sp.											x			x	
Padina tenuis Bory	x	x										x			
Sargassum cristaefolium J. Agardh	x					x						x			x
Turbinaria ornata (Turner) J. Agardh							x				x	x			
Rhodophyta															
Amphiroa fragilissima (L.) Lamx.		x	x												
Galaxaura sp.						x									x
Gracilaria edulis (Gmel.) Silva	x	x										x			
Jania capillacea Harvey	x	x									x	x			
Anthophyta															
Cymodocea rotundata Ehrenb. & Hempr.	x											x			
Enhalus acoroides (L. F.) Royle	x											x			
Thalassia hemprichii (Ehrenb) Aschers.	x											x			
Number of species per transect	12	11	5	3	0	5	4	3	3	7	10	11	7	6	6

Total number of genera = 21
Total number of species = 26

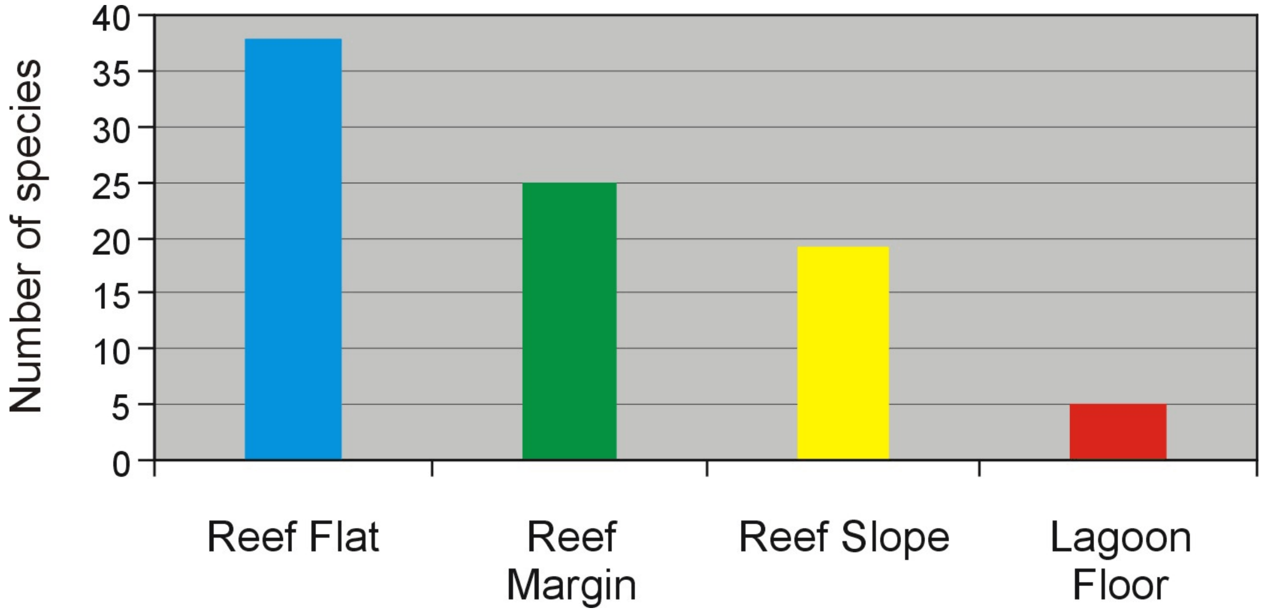


Figure 6. Alpha diversity of marine plants in the general physiographic zones.

from the shoreline (Transect 12). At the time of the study, *Enhalus acoroides* was observed to be flowering.

Two deep dives were made to examine the flora of the bottom. High turbidity produces low light penetrability at deeper depths, making it impossible for plant communities to be established. On the submerged reef (Transect 6) at 7.5 m, some turf algae were observed along with the fleshy brown algae *Dictyota bartayresii*.

Two species of coralline algae were recorded at the study site. Because of the difficulty in identifying these species, they were described as needle-shaped type and round-and-warty-surface types. Both species were commonly seen in most of the transects in the study site.

Epiphytic algae were abundant as biofouling filaments on seagrass blades, especially in the area of Transect 1. Farmer fishes, especially *Stegastes nigricans*, were observed guarding their small algal farms in the reef margin areas, producing a mosaic distribution of turf algae in those zones.

Table 8. Percent substrate cover of marine plants recorded from on transects of reef areas A, B, and C east of Dekehtik Island for the proposed extension of the Pohnpei International Airport runway, Kolonia, Pohnpei.

	Transect														
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chlorophyta															
Boodlea composita (Harv.) Brand															
Caulerpa serrulata (Forsk.) J. Ag.															
Caulerpa sertularioides (West) C. Ag.															
Chlorodesmis fastigiata Harvey															
Halimeda macroloba Decaisne										1.88					
Halimeda macrophysa Askenasy			6.58	14.69			8.13	2.81	4.69	2.50	5.00		2.81	2.19	
Halimeda cylindracea Decaisne											0.31				
Halimeda opuntia (L.) Lamx.	0.31	4.69					1.56		4.69	2.50	0.94	1.56	1.25		
Neomeris annulata Dickie	0.63	0.94													
Tydemannia expeditionis W. V. Bosse													1.56		
Valonia ventricosa J. Agardh															
Cyanophyta															
Microcoleus lyngbyaceus (Kutz. Crouan)															
Schizothrix calcicola (Ag.) Gomont															
Phaeophyta															
Dictyota bartayresii Lamx.		1.88								0.31					
Dictyota cervicornis Kutz		0.63													
Ectocarpus sp.															
Padina tenuis Bory	2.81	7.18													
Sargassum cristaefolium J. Agardh	5.93														
Turbinaria ornate (Turner) J. Agardh															
Rhodophyta															
Amphiroa fragilissima (L.) Lamx.															
Galaxaura sp.															

Table 8. Continued.

	Transect														
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Gracilaria edulis (Gmel.) Silva	0.98	0.31										18.75			
Jania capillacea Harvey												0.63			
Anthophyta															
Cymodocea rotundata Ehrenb. & Hempr.															
Enhalus acoroides (L. F.) Royle															
Thalassia hemprichii (Ehrenb) Aschers.															

Macroinvertebrates

The distribution and abundance of conspicuous epibenthic macroinvertebrates occurring on 14 transects at Dekehtik Island are reported in Table 9. Forty-nine species of macroinvertebrates in eight phyla were encountered on the transects, and 41 additional species were observed in areas adjacent to the transects (Table 10). Thirteen of the 49 species occurred as single individuals on single transects. The greatest α diversity (i.e., 19 species) was found on the reef slope (Transect 10), and the least (i.e., one unidentified species of sponge) on the muddy lagoon floor of Transect 5 (Figure 7).

Reef flats dominated by seagrasses (Transects 1 and 12) were depauperate of epibenthic macroinvertebrates, probably because these areas are exposed subaerially at low tides. It is quite possible, however, that there is a considerable infaunal community in the seagrass meadows, as

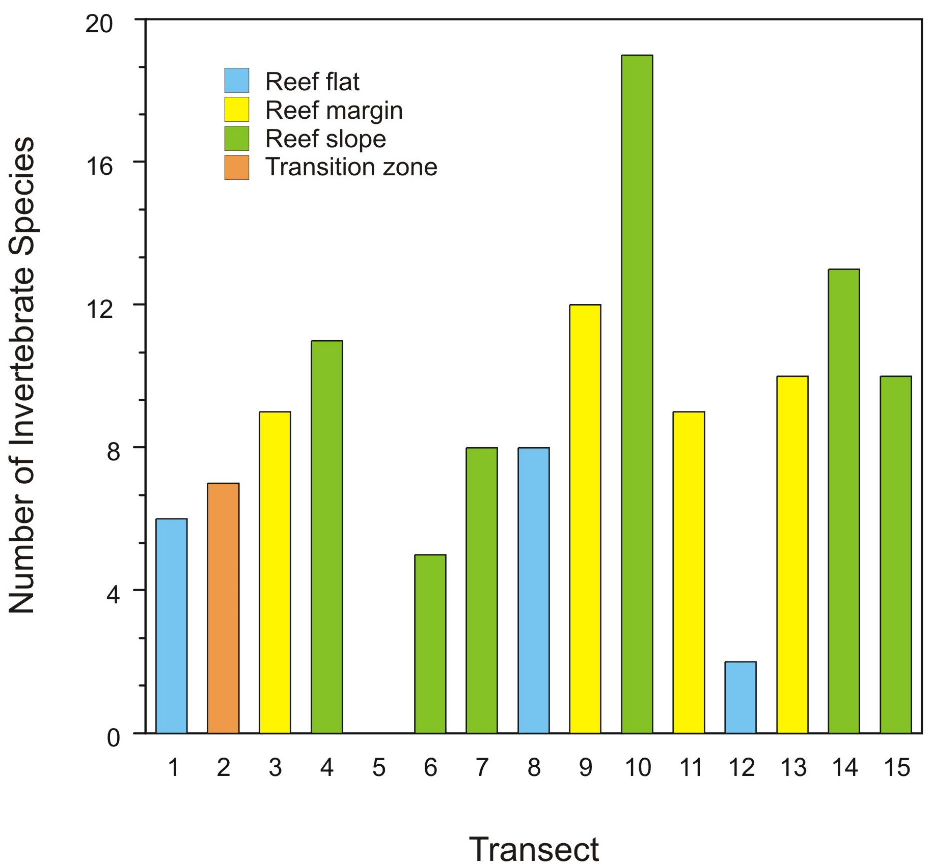


Figure 7. Numbers of invertebrate species observed on transects (n = 15) at the detailed study site.

Table 9. Densities of conspicuous epibenthic invertebrates in reef communities east of Dekehtik Island, Pohnpei. Densities are reported as means ± standard errors in ten replicate 20-m^2 plots on each belt transect, except Transects 5 and 6. Transect 5 was established over a muddy lagoon floor inhabited by a single sponge, and Transect 6 consisted of three 20-m^2 plots on a coral knoll that was 30 m in diameter.

	Transect														
Taxon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PORIFERA															
Leucetta cf. *chagosensis*														0.5±0.3	
Spheciospongia sp.	13.0±4.5											5.8±2.9			
Stylissa massa									0.1±0.1	0.1±0.1					0.8±0.4
Callyspongia sp.									3.7±1.0	1.2±0.6				0.5±0.3	1.2±0.6
Haliclona spp.		1.5±0.8													
Cinachyra sp.	0.2±.01			0.1±0.1											
cf. *Tetilla* sp.			0.1±0.1												
CNIDARIA (nonscleractinian)															
Megalactis hemprichii															0.1±0.1
Heteractis magnifica								0.1±0.1							
Stichodactyla mertensii	0.1±0.1														
Cirripathes sp. 1				0.2±0.2		0.7±0.7			1.0±0.3	0.5±0.3				0.6±0.3	0.6±0.2
Cirripathes sp. 2									0.3±0.2	0.1±0.1				0.1±0.1	
Sarcophyton spp.									0.6±0.4	1.1±0.4				0.9±0.7	7.0±3.3
Sinularia polydactyla			10.8±8.2	3.1±1.3			0.3±0.3								
Sinularia sp. aff. *S. dura*						0.3±0.3				8.6±4.0					
Sinularia sp. 1						184.3±14.6									74.4±23.0
Sinularia sp. 2									0.3±0.2	1.8±1.4			0.2±0.2		
cf. *Astrogorgia* spp.															0.2±0.2
PLATYHELMINTHES															
Pseudoceros indicus	0.2±.01														
ANNELIDA															
Sabellastarte sanctijosephi			1.0±0.3	0.1±0.1			0.4±0.2	0.5±0.2	0.3±0.2	0.5±0.4	0.4±0.3		0.4±0.3	0.4±0.2	
MOLLUSCA															
Trochus maculatus		0.1±0.1													
Cypraea tigris	0.2±.01			0.2±0.2				0.1±0.1							
Chicoreus brunneus			0.1±0.1							0.1±0.1	0.2±0.1		0.1±0.1		
Drupa rubusidaeus											0.2±0.1		0.1±0.1		
Coralliophila violacea		0.2±.01	13.5±2.8	11.1±2.5			2.6±0.8	8.5±1.9	0.9±0.3	6.1±2.3	10.6±2.2		19.5±3.7	5.5±1.7	

Table 9. Continued.

Taxon	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vasum turbinellus			0.1±0.1				0.1±0.1			0.1±0.1	0.5±0.2		0.3±0.2		
Conus sanguinolentus												0.2±0.1			
Conus virgo														0.1±0.1	
Phyllidiella pustulosa				0.2±.01											
Septifer bilocularis			3.2±0.8	1.5±0.4			3.4±1.2	6.6±0.6	0.1±0.1	0.1±0.1	3.8±0.6		4.4±1.1		
Arca ventricosa		0.6±0.5	61.8±6.9	11.2±2.7			13.6±2.9	96.5±8.7	1.8±.05	1.6±0.7	55.9±7.4		64.7±7.5	3.5±1.2	
Atrina vexillum										0.1±0.1					
Spondylus squamosus										0.1±0.1					
Spondylus varius														0.1±0.1	
Chama spp.				0.3±0.2			0.3±0.2								
ARTHROPODA															
Periclimenes brevicarpalis	0.2±.01														
ECHINODERMATA															
Diadema sp.			0.1±0.1												
Echinometra mathaei		0.1±0.1									0.1±0.1				
Personothuria graeffei										0.1±0.1					
Holothuria edulis										1.7±0.4				1.1±.05	
Stichopus hermanii															0.1±0.1
Stichopus vastus										0.1±0.1					
Opheodesoma sp.						0.3±0.3									
Choriaster granulatus									0.1±0.1	0.4±0.2					0.1±0.1
Culcita novaeguineae						0.7±0.3								0.1±0.1	0.1±0.1
Linckia laevigata		0.1±0.1					0.6±0.3	1.3±0.3	0.1±0.1						
Acanthaster planci													0.1±0.1		
Alloeocomatella sp.														0.1±0.1	
CHORDATA															
Polycarpa spp.			1.8±0.6	0.2±0.1				0.6±0.2			0.8±0.5		1.0±0.5		

Table 10. List of macroinvertebrate species observed in each physiographic zone in the reef communities east of Dekehtik Island, Pohnpei. Filled circles (●)represent observations of living specimens, and empty circles (○) represent observations of dead specimens.

	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PORIFERA															
Leucetta cf. *chagosensis*														●	
Dysidea spp.		●	●				●		●	●			●	●	
Spheciospongia spp.	●											●			
Stylissa massa									●					●	●
Callyspongia sp.				●					●	●				●	●
Haliclona spp.		●													
Cinachyra spp.	●											●	●		
cf. *Tetilla* spp.			●												
CNIDARIA (nonscleractinian)															
Protopalythoa sp.						●				●					
Rhodactis howesii				●											
Megalactis hemprichii						●									●
Heteractis magnifica						●	●								
Stichodactyla mertensii	●														
Cirripathes sp. 1				●		●			●	●				●	●
Cirripathes sp. 2									●					●	
Sarcophyton spp.									●	●				●	●
Sinularia polydactyla			●	●			●								
Sinularia sp. aff. *S. dura*						●				●					●
Sinularia sp. 1						●									●
Sinularia sp. 2									●	●			●		
cf. *Astrogorgia* spp.										●					●
PLATYHELMINTHES															
Pseudoceras indicus	●							●							
ANNELIDA															
Sabellastarte sanctijosephi		●	●	●			●	●	●		●		●	●	
ECHIURA															
bonelliid sp.				●		●									
MOLLUSCA															
Trochus maculatus		●					○								
Tectus triserialis								○							
Astraea rhodostoma													●		
Cerithium nodulosum												○			
Cerithium rostratum	●														
Strombus gibberulus	○	○										○			
Strombus luhuanus													●		
Strombus mutabilis		○													
Strombus urceus												○			
Lambis lambis	○											○			
Dendropoma maxima											●		●		
Cypraea erosa		○		○											
Cypraea lynx		○													
Cypraea moneta							●								
Cypraea tigris	●	○	○	●				●							

Table 10. Continued.

	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Polinices mammilla												○			
Cymatium muricinum	○														
Gyrineum gyrinum														○	
Chicoreus brunneus			●				○		○	●	●		●		
Drupa rubusidaeus											●		●		
Coralliophila violacea		●	●	●			●	●	●	●	●		●	●	
Vasum turbinellus			●				●				●		●		
Mitra eremitarum		○											●		
Conus litteratus			●												●
Conus magus	○														
Conus marmoreus			○												
Conus sanguinolentus												●			
Conus virgo														●	
Phyllidiella pustulosa				●											
Modiolus auriculatus												○			
Septifer bilocularis			●	●			●	●	●		●		●		
Anadara antiquata	○	○													
Arca ventricosa		●	●	●			●	●	●	●	●		●	●	
Barbatia spp.		●	●	●			●	●	●	●	●		●	●	
Atrina vexillum									●					●	
Gloriapallium pallium														●	
Spondylus squamosus										●					
Spondylus varius														●	
Spondylus spp.										●					
Hyotissa hyotis										●				●	
cf. *Alectryonella plicatula*								●	●						
Chama spp.				●			●				●				
Geloina coaxans	○	○													
Gafrarium pectinatum	○														
Periglypta puerpera	○								○					○	
Pitar prora	○														
ARTHROPODA															
Periclimenes brevicarpalis	●														
Dardanus spp.							●								
ECHINODERMATA															
Diadema sp.			●												
Echinometra mathaei		●									●				
Bohadscia argus		●	●												
Holothuria edulis				●			●			●				●	
Holothuria flavomaculata			●												
Stichopus hermanii			●												●
Opheodesoma sp.						●									
Choriaster granulatus									●	●					●
Culcita novaeguineae						●								●	●
Linckia laevigata		●					●	●	●						
Acanthaster planci		○											●	●	
Alloeocomatella sp.														●	
CHORDATA															
Didemnum molle						●							●	●	

Table 10. Continued.

	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eudistoma toealensis	•	•	•				•			•	•		•		
Phallusia julinea										•				•	
Rhopalaea spp.				•		•			•	•				•	
Polycarpa spp.			•	•				•			•		•	•	
cf. *Symplegma* spp.														•	

indicated by observations of the dead shells of five species of infaunal bivalves and three species of burrowing gastropods. The most abundant macroinvertebrate species found in the seagrass meadows was the sponge *Spheciospongia* sp. Other species were distributed sporadically, usually associated with scattered rocks.

The transition zone (Transect 2) between the seagrass meadow and the reef margin on the fringing reef at Dekehtik Island supported species characteristically associated with hard substrates, although in low abundances ($<1 \cdot 20\ m^{-2}$). Two of the six species found on this transect, *Coralliophila violacea* and *Arca ventricosa*, are associated with massive *Porites* corals; these two species were encountered with the greatest frequency (10 of the 14 transects). Like the adjacent seagrass meadow, this zone also provides habitat for infaunal species in scattered depressions filled with sand and silt.

Belt transects on the reef margins revealed a greater α diversity of macroinvertebrates (20 species) than on either the reef flats (7 species) or transition zone (6 species) (Tables 7 and 8). The most abundant of these species were those associated with massive *Porites* corals. The ark clam *Arca ventricosa* bores a cylindrical burrow into the skeletal matrix of *Porites* colonies and withdraws into the burrow hole when threatened. These burrows may be inhabited secondarily by the mussel *Septifer bilocularis* and the tunicate *Polycarpa* spp. The significance of the relationship between the ark clam and *Porites australiensis* in the present study is remarkable. *Arca ventricosa* was found on 10 of the 11 transects in which *Porites australiensis* occurred (Tables 3 and 7), and *Septifer bilocularis* occurred on 8 of the 10 transects where *Arca ventricosa* was found. With the exception of the reef margin at Transect 9, the greatest densities of *Arca ventricosa* occurred where the colony coverage by *Porites* spp. was high (Tables 4 and 7).

The third species of macroinvertebrate that is associated with *Porites* species is the corallivorous gastropod *Coralliophila violacea*. These snails are parasitic on colonies of all coral species in the genus *Porites*. Like *Arca ventricosa*, *Coralliophila violacea* occurred on 10 of the 11 transects in which *Porites australiensis* was found. However, unlike *Arca ventricosa*, *Coralliophila violacea* was also found on *Porites cylindrica* and *Porites rus*.

Reef slopes on Transects 10 and 14 had the greatest number of species, with 19 and 13 species, respectively. The slight increase can be attributed to greater numbers of species of molluscs and echinoderms on the reef slopes.

Comparison of macroinvertebrate community structure across transects by cluster analysis indicates that there is some overlap of invertebrates in the physiographic zones recognized in this study (Figure 8). The reef margins of Transects 11 and 13 were most similar, and they were similar to the reef margin of Transect 3. However, for macroinvertebrates the reef

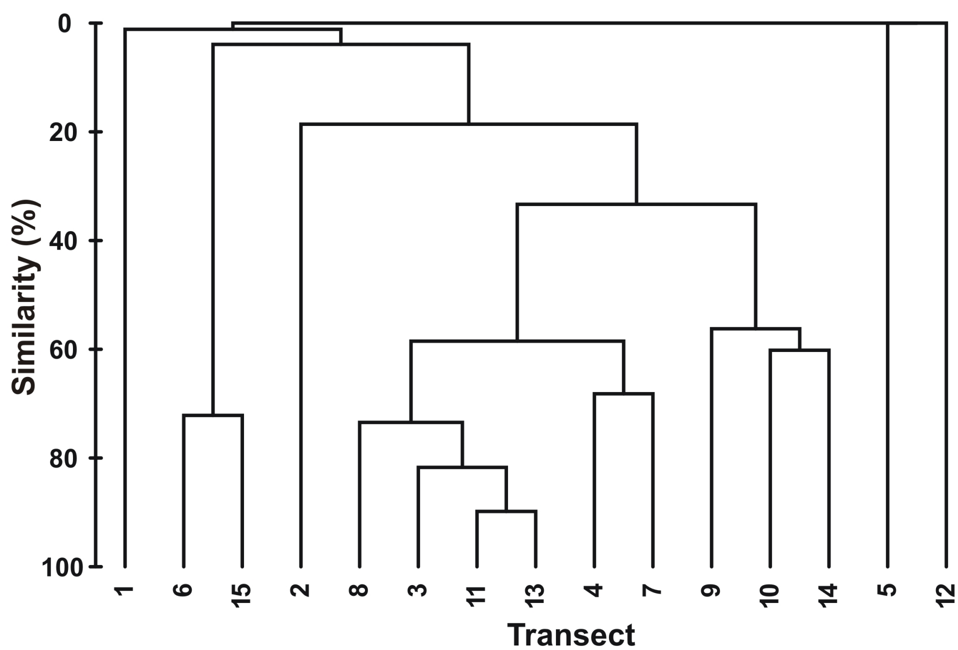


Figure 8. Cluster analysis (group averaging) of macroinvertebrate assemblage relationships between transects at the Pohnpei Airport Runway study site. Values of similarity (0 to 100%) were calculated in pair-wise comparisons with the Bray-Curtis similarity index and then assembled in a matrix prior to cluster analysis.

flat of Transect 8 is more similar to these reef margins than to the other reef flats. Together, these four transects clustered with the reef slope communities of Transects 4 and 7. A second cluster was formed by the reef slopes of Transects 10 and 14, which were similar to the reef margin of Transect 9. The deeper macroinvertebrate communities of Transects 6 and 15 form a third cluster. The reef flat of Transects 1 and 12 and the lagoon floor of Transect 5 show no similarity to the other transects.

MDS analysis of macroinvertebrate assemblages indicated two highly-similar groups (Figure 9), with habitats dominated largely by coral cover. Transects 3, 4, 7, 8, 11, and 13 formed one group, and Transects 9, 10, and 14 formed the other. Transects 6 and 15 paired together, but Transects 1, 2, 5, and 12 were not similar to other transects or to each other. A stress level of 0.01 indicates a high level of significance in the relationships represented by this analysis.

The macroinvertebrate assemblages found at Dekehtik Island during this survey are comparable to those reported in other studies. Trans Asia Engineering (1977) reported 26

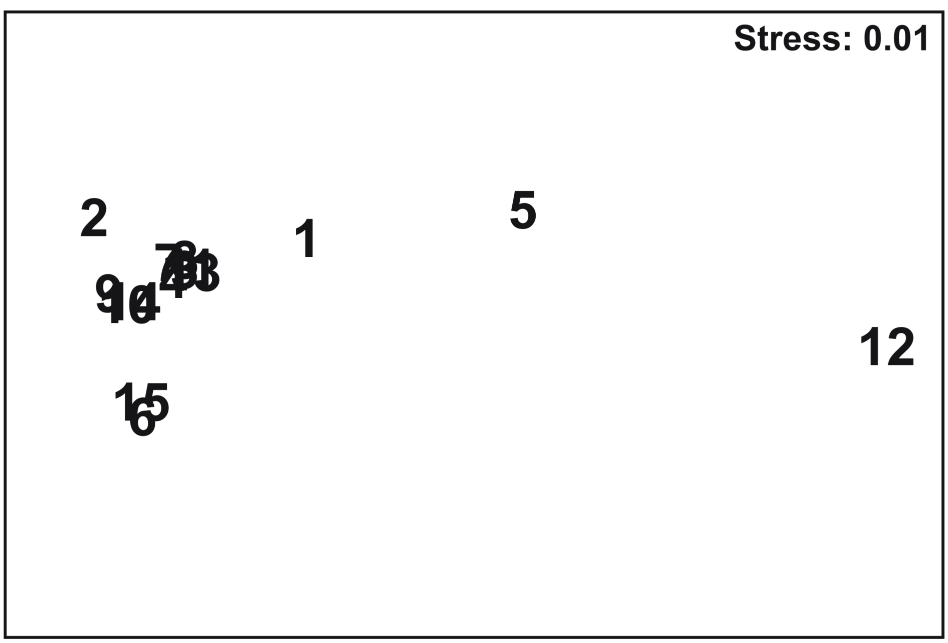


Figure 9. Multidimensional Scaling (MDS) analysis of macroinvertebrate assemblage relationships between transects at the Dekehtik Island study site.

species of macroinvertebrates on transects, compared to 49 in the present study. Neither figure is remarkably high for invertebrate assemblages in tropical coral reef environments. Trans Asia Engineering also noted the absence of echinoids on transects, and only three individuals were encountered in transects in this survey.

Authors have commented on the diversity of suspension-feeding species in the lagoon environment in Pohnpei, including bivalves, sponges, and crinoids (Trans Asia Engineering, 1977; Smalley, 1980; USACOE, 1986). Suspension feeders account for 57% of the macroinvertebrate species observed on transects in this survey. The predominance of suspension feeders in lagoonal environments may be a result of nutrient enrichment by terrestrial run-off and the extended residence time of waters in the lagoon.

Fishes

The number of fish species observed at the detailed study site was 209, of which 150 species were observed on transects and 59 within the study area (Tables 11 and 12). These species comprise 35 families and at least 114 genera of reef fishes (three species remain to be identified correctly—one may be a new species of damselfish). The total number of species observed at the 15 transect stations (Figure 10) ranged from 1 to 55 (mean = 33.1, standard deviation, SD = 15.45). The greatest number of species occurred at Transect 14, and the least at Transect 5 (Table 13) . Species diversity (Shannon index, H'; Figure 11) ranged from 0.0 (Transect 5) to 3.0971 (Transect 8) (mean = 2.24, SD = 0.91).

The total number of individual fishes (Figure 12) ranged from 2 to 2,568 (mean = 423, SD = 619.32). Transect 14 had the greatest abundance of fishes, and Transect 5 the least. The most abundant species seen in all transects combined were: *Ostorhinchus lateralis* (Apogonidae, n = 2,091), *Amblyglyphididon curacao* (Pomacentridae, n = 398), *Ctenochaetus striatus* (Acanthuridae, n = 383), *Rhabdamia cypselurus* (Apogonidae, n = 301), *Thalassoma amblycephalum* (Labridae, n = 272), *Chrysiptera cyanea* (Pomacentridae, n = 270), *Chrysiptera traceyi* (Pomacentridae, n = 250), *Eviota sebreei* (Gobiidae, n = 224), *Spratelloides delicatulus* (Clupeidae, n = 200), and *Meiacanthus atrodorsalis* (Blenniidae, n = 195). All of these species are relatively small-sized (less than 15 cm TL). *Amblyglyphididon curacao*, *Chrysiptera cyanea*,

Table 11. Distribution of fishes at the proposed Pohnpei Airport runway extension site.

	Transect														
Family and species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dasyatidae															
Himantura grannulata															
Clupeidae															
Spratelloides delicatulus											100		100		
Herklotsichthys quadrimaculatus															
Synodontidae															
Saurida gracilis			1	1			1		1						
Synodontus binotatus						1									
Synodontis variegatus															
Mugilidae															
Crenimugil crenilabis															
Ellochelon vaigiensis															
Belonidae															
Platybelone argalus platyura															
Hemiramphidae															
Hemiramphus far															
Hemiramphus lutkei												2			
Holocentridae															
Myrpristes adusta														3	
Myrpristes berndti															
Myrpristes kuntee							1	3		1	1				
Myrpristes murdjan			2	1				1			1				
Neoniphon argenteus															
Neoniphon opercularis			5	4			3	3	1	1	3		3		
Neoniphon sammara									1						1
Sargocentron diadema								1							
Sargocentron spiniferum				1											
Fistulariidae															
Fistularia commersoni															

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Serranidae															
Cephalopholis urodeta															
Epinephelus hexagonatus			1	1			2	2						1	
Epinephelus maculatus						1									
Epinephelus merra		1	1			1		1	1						
Epinephelus polyphekadion															1
Epinephelus spilotoceps							1						1		
Belonoperca chabanaudi															
Cirrhitidae															
Cirrhitichthys oxycephalus			2												
Paracirrhites arcatus									1						
Pseudochromidae															
Pseudochromis marshallensis															
Apogonidae															
Archamia fucata				5											
Cheilodipterus isostigmus				12		7	1	2	6	1				2	
Foa brachygramma															
Fowleria marmorata															
Ostorhinchus lateralis														2090	1
Ostorhinchus nigrofasciatus	3	3										33			
Ostorhinchus thermalis															
Rhabdamia cypselurus						301									
Zoramia "fragilis"															
Zoramia leptacantha													50		
Carangidae															
Alectis indicus															1
Caranx melampygus															1
Gnathodon speciousus															

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lutjanidae															
Lutjanus ehrenbergi							1	1							
Lutjanus fulvus			4	1				2	1				1	1	
Lutjanus gibbus												7			1
Lutjanus monostigmus															
Lutjanus semicinctus			1												
Caesionidae															
Pterocaesio lativittata															
Pterocaesio pisang						70									1
Haemulidae															
Plectorhinchus vittatus															
Lethrinidae															
Gnathodentex aurolineatus			1	9				8	16	1			2	14	
Gymnocranius euanus															
Lethrinus harak			5									46			
Lethrinus olivaceus												1			
Monotaxis grandoculis														1	
Nempteridae															
Scolopsis lineata							2	5			1				
Mullidae															
Mulloidichthys flavolineatus			1					1							
Parupeneus barberinus			2							1		1	1	3	
Parupeneus crenalabris															1
Parupeneus cyclostomus											1				
Parupeneus multifasciatus			1							1			2	2	
Chaetodontidae															
Chaetodon auriga				2								4		2	
Chaetodon bennetti				1											
Chaetodon citrinellus				1			5		1						

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chaetodon ephippium			2						2					2	
Chaetodon kleinii						2									
Chaetodon lineolatus															
Chaetodon lunula															1
Chaetodon lunulata			6	2			6	6	3	3	2		8	6	2
Chaetodon melannotus				2		3		1							
Chaetodon ornatissimus				1											
Chaetodon rafflesii									1		1		1		
Chaetodon reticulatus							1	2							
Chaetodon ulietensis				1					2		2		1	1	
Forcipinger flavissimus															
Heniochus acuminatus			3												
Heniochus chrysostomus				1											1
Heniochus varius				3		2		2	1					2	
Pomacanthidae															
Centropyge bicolor						1			3						
Centropyge flavissimus				1											
Centropyge vrolicki			4				1	8	1		1		3	1	1
Pygoplites diacanthus			2	3		1	1		1	1	1			5	
Pomacentridae															
Amphiprion chrysopterus								2					5		
Amphiprion clarki															
Amphiprion perideraion						4									
Chromis atripectoralis															
Chromis margaritifer								5	3				3	1	
Chromis scotochiloptera				6		5		8	13				60	24	1
Dascyllus aruanus				3					2					1	
Dascyllus reticulatus									2						
Dascyllus trimaculatus						2		7							

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Amblygliphididon curacao			96	74		4	12	33	44	9	3		107	16	
Chrysiptera biocellatus	22	2										2			
Chrysiptera cyanea		7	66	27		10	4	8	26	3	8		76	34	1
Chrysiptera traceyi			9	28		4	6		35	65	15		27	60	1
Chrysiptera sp.						3			1	8					
Pomacentrus amboinensis			1										1	8	1
Pomacentrus chrysurus			3	7				5	6					2	
Pomacentrus vaiuli				1											
Stegastes lividus			4												
Labridae															
Cheilinus fasciatus			1	1				1		2				2	1
Cirrhilabrus katherinae						7				2				5	
Epibulus insidiator														2	1
Oxycheilinus unifasciatus				1		2								1	
Pseudocheilinus hexataenia														1	
Pterogogus cryptus															
Anampses meleagrides											1		1		
Gomphosus varius			1	1			1	4			1				
Halichoeres chlopterus	1											2			
Halichoeres hortulanus							1							1	
Halichoeres marginatus				1											
Halichoeres melanurus		4	2	3			2	7	1	10	6		15	7	
Halichoeres richmondi							3			1					
Hemigymnus melapterus								1					1		
Pseudocoris yamashiroi			1				2	1		1	1				
Stethojulis strigiventer	1					1	1				3				
Thalassoma amblycephalum		1	42	6			1	33	18	8	90		16	56	1
Thalassoma hardwicke				1				2			1			2	
Thalassoma lunare			2						2	1	4		2	3	

Table 11. Continued.

	Transect														
Family and species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Labrichthys unilineatus			1	2						2			1		
Labroides dimidiatus		1	3	2		1	4	4	2	3	4		7	4	
Green seagrass wrasse	9											3			
Cheilio inermis															
Chlorurus bowersi															
Chlorurus microrhinos				1											
Chlorurus sordidus			3	3			5	7		26	3		4	7	1
Hipposcarus longiceps															
Leptoscarus vaigiensis															
Scarus dimidiatus									1					1	
Scarus globiceps															
Scarus psittacus			1	1						8			3	9	
Scarus schlegeli									2					2	
Pinguipedidae															
Parapercis clathrata															
Trichonotidae															
Trichonotus elegans		11													
Tripterygiidae															
Ulca xenogrammus								1						1	
Blenniidae															
Meiacanthus atrodorsalis			4	14			4	10	75	37			1	49	1
Petroscirtes xestus												3			
Plagiotremus rhynorhynchus									2						
Ecsenius bicolor													1		
Salarias fasciatus															
Callionymidae															
Callionymus simplicornis														1	

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Gobiidae															
Periophthalmus kalolo															
Amblyeleotris gymnocephalus															
Cryptocentrus strigilliceps	1	7		6			7		2	2		3			1
Cryptocentrus sp. A															
Ctenogobiops aurocingulus														7	
Amblygobius decussatus		10	1	24		1	22			38				53	
Amblygobius hectori															
Amblygobius phaelena	1	3													
Amblygobius rainfordi			5				5			13	1			15	
Oblopomus oplopomus															1
Valenciennea strigata															
Asteropteryx semipunctatus	7	27					2					51		2	
Bryaninops amplus										1					
Coryphopterus signipinnis				1						2					
Eviota albolineata				1											
Eviota bifasciata															
Eviota prasina															
Eviota punctulata				10			4			5	1			1	
Eviota sebreei		11	11	13		1		19	5	46	109			9	
Eviota sigillata		1	2						1	4				7	
Eviota sp. B										8				3	
Exyrias bellissimus						2			3	1					
Gnatholepis anjerensis		2		1						3		2			
Gnatholepis cauerensis		9										1			
Istigobius decoratus		6		1			1			1					
Istigobius spence		2			2		2								
Macrodontogobius wilburi							1		1					3	1
Oxyurichthys papuensis															1

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Grey-barred goby on flat		1													
White-spotted goby		9													
Microdesmidae															
Gunnellichthys viridescens															
Ptereleotris heteroptera													3		
Ptereleotris microlepis															
Siganidae															
Siganus puellus															1
Siganus spinus															
Siganus vulpinnus															
Zanclidae															
Zanclus cornutus			1			1									
Acanthuridae															
Acanthurus blochii												2			
Acanthurus dussemieri			1												
Acanthurus lineatus								1							
Acanthurus nigricauda			1			1									
Acanthurus nigrofuscus		4	20	13		1	32	20	1		16			6	
Acanthurus nigoris							1	2							
Acanthurus olivaceus										1					
Acanthurus pyroferus															
Acanthurus triostegus															
Acanthurus xanthopterus			1			1	1								
Ctenochaetus binotatus						1							1		
Ctenochaetus striatus		31	47	18		3	68	46		6	47		93	24	
Zebrasoma scopas			2	3			1	7		1			18	1	
Zebrasoma veliferum							1								
Naso lituratus								1							1

Table 11. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Balistidae															
Balistapus undulatus															1
Balistoides viridescens															
Rhinecanthus aculeatus		1													
Rhinecanthus rectangulus												1			
Sufflamen chrysoptera															
Tetraodontidae															
Canthigaster janthinoptera				1											
Canthigaster solandri															

Table 12. Presence-absence of fish species in the general study area at the proposed Pohnpei Airport runway extension site. NR = new record; P = present at site (on or off transects); Total = total on all transects (0 = absent from transects).

Family and species	NR	P	Total
Dasyatidae			
Himantura grannulata		1	0
Clupeidae			
Spratelloides delicatulus		1	200
Herklotsichthys quadrimaculatus		1	0
Synodontidae			
Saurida gracilis		1	4
Synodontus binotatus		1	1
Synodontis variegatus	?	1	0
Mugilidae			
Crenimugil crenilabis	1	1	0
Ellochelon vaigiensis		1	0
Belonidae			
Platybelone argalus platyura		1	0
Hemiramphidae			
Hemiramphus far	?	1	0
Hemiramphus lutkei		1	2
Holocentridae			
Myrpristes adusta		1	3
Myrpristes berndti		1	0
Myrpristes kuntee		1	6
Myrpristes murdjan		1	5
Neoniphon argenteus		1	0
Neoniphon opercularis		1	23
Neoniphon sammara		1	1
Sargocentron diadema		1	1
Sargocentron spiniferum		1	1
Fistulariidae			
Fistularia commersoni		1	0
Serranidae			
Cephalopholis urodeta		1	0
Epinephelus hexagonatus		1	7
Epinephelus maculatus		1	1
Epinephelus merra		1	5
Epinephelus spilotoceps		1	2
Belonoperca chabanaudi		1	0
Cirrhitidae			
Cirrhitichthys oxycephalus		1	2
Paracirrhites arcatus		1	1
Pseudochromidae			
Pseudochromis marshallensis		1	0

Table 12. Continued.

Family and species	NR	P	Total
Apogonidae			
Apogon sangiensis	?	1	0
Archamia fucata		1	5
Cheilodipterus isostigmus		1	31
Foa brachygramma	?	1	0
Fowleria marmorata		1	1
Ostorhinchus lateralis		1	2090
Ostorhinchus nigrofasciatus		1	39
Ostorhinchus thermalis	?	1	0
Rhabdamia cypselurus		1	301
Zoramia "fragilis"		1	0
Zoramia leptacantha		1	50
Carangidae			
Alectis indicus	1	1	0
Caranx melampygus		1	0
Gnathodon speciousus		1	0
Lutjanidae			
Lutjanus ehrenbergi		1	2
Lutjanus fulvus		1	10
Lutjanus gibbus		1	7
Lutjanus monostigmus		1	0
Lutjanus semicinctus		1	1
Caesionidae			
Pterocaesio lativittata		1	0
Pterocaesio pisang		1	70
Haemulidae			
Plectorhinchus vittatus		1	0
Lethrinidae			
Gnathodentex aurolineatus		1	51
Gymnocranius euanus		1	0
Lethrinus harak		1	51
Lethrinus olivaceus		1	1
Monotaxis grandoculis		1	1
Nempteridae			
Scolopsis lineata		1	8
Mullidae			
Mulloidichthys flavolineatus		1	2
Parupeneus barberinus		1	8
Parupeneus crenalabris		1	0
Parupeneus cyclostomus		1	1
Parupeneus multifasciatus		1	6

Table 12. Continued.

Family and species	NR	P	Total
Chaetodontidae			
Chaetodon auriga		1	8
Chaetodon bennetti		1	1
Chaetodon citrinellus		1	7
Chaetodon ephippium		1	6
Chaetodon kleinii		1	2
Chaetodon lineolatus		1	0
Chaetodon lunula		1	0
Chaetodon lunulata		1	42
Chaetodon melannotus		1	6
Chaetodon ornatissimus		1	1
Chaetodon rafflesii		1	3
Chaetodon reticulatus		1	3
Chaetodon ulietensis		1	7
Forcipinger flavissimus		1	0
Heniochus acuminatus		1	3
Heniochus chrysostomus		1	1
Heniochus varius		1	10
Pomacanthidae			
Centropyge bicolor		1	4
Centropyge flavissimus		1	1
Centropyge vrolicki		1	19
Pygoplites diacanthus		1	15
Pomacentridae			
Amphiprion chrysopterus		1	7
Amphiprion clarki		1	0
Amphiprion perideraion		1	4
Chromis atripectoralis		1	0
Chromis margaritifer		1	12
Chromis scotochiloptera		1	116
Dascyllus aruanus		1	6
Dascyllus reticulatus		1	2
Dascyllus trimaculatus		1	9
Amblygliphididon curacao		1	398
Chrysiptera biocellatus		1	26
Chrysiptera cyanea		1	269
Chrysiptera traceyi		1	249
Chrysiptera sp.		1	12
Pomacentrus amboinensis		1	10
Pomacentrus chrysurus	1	1	23
Pomacentrus vaiuli		1	1
Stegastes lividus		1	4

Table 12. Continued.

Family and species	NR	P	Total
Labridae			
Cheilinus fasciatus		1	7
Cirrhilabrus katherinae		1	14
Epibulus insidiator		1	2
Oxycheilinus unifasciatus		1	4
Pseudocheilinus hexataenia		1	1
Pterogogus cryptus		1	0
Anampses meleagrides		1	2
Gomphosus varius		1	8
Halichoeres chlopterus	1	1	3
Halichoeres hortulanus		1	2
Halichoeres marginatus		1	1
Halichoeres melanurus		1	57
Halichoeres richmondi		1	4
Hemigymnus melapterus		1	2
Pseudocoris yamashiroi		1	6
Stethojulis strigiventer		1	6
Thalassoma amblycephalum		1	271
Thalassoma hardwicke		1	6
Thalassoma lunare		1	14
Labrichthys unilineatus		1	6
Labroides dimidiatus		1	35
Green seagrass wrasse		1	12
Cheilio inermis		1	0
Chlorurus bowersi		1	0
Chlorurus microrhinos		1	1
Chlorurus sordidus		1	58
Hipposcarus longiceps		1	0
Leptoscarus vaigiensis		1	0
Scarus dimidiatus		1	2
Scarus globiceps		1	0
Scarus psittacus		1	22
Scarus schlegeli		1	4
Pinguipedidae			
Parapercis clathrata		1	0
Trichonotidae			
Trichonotus elegans		1	11
Tripterygiidae			
Ulca xenogrammus		1	2
Blenniidae			
Meiacanthus atrodorsalis		1	194
Petroscirtes xestus		1	3
Plagiotremus rhynorhynchus		1	2

Table 12. Continued.

Family and species	NR	P	Total	
Ecsenius bicolor		1	1	
Salarias fasciatus		1	0	
Callionymidae				
Callionymus simplicornis		1	1	
Gobiidae				
Periophthalmus kalolo		1	0	
Amblyeleotris gymnocephalus	?	1	0	
Cryptocentrus strigilliceps		1	28	
Cryptocentrus sp. A	?	1	0	
Ctenogobiops aurocingulus		1	7	
Amblygobius decussatus		1	149	
Amblygobius hectori		1	0	
Amblygobius phaelena		1	5	
Amblygobius rainfordi		1	39	
Oblopomus oplopomus		1	0	
Valenciennea strigata		1	0	
Asteropteryx semipunctatus		1	89	
Bryaninops amplus	1	1	1	
Coryphopterus signipinnis		1	3	
Eviota albolineata		1	1	
Eviota bifasciata		1	0	
Eviota prasina	?	1	0	
Eviota punctulata		1	21	
Eviota sebreei		1	224	
Eviota sigillata		1	15	
Eviota sp. B	?	1	11	
Exyrias bellissimus		1	6	
Gnatholepis anjerensis		1	8	
Gnatholepis cauerensis	?	1	10	
Istigobius decoratus		1	9	
Istigobius spence		1	6	
Macrodontogobius wilburi		1	5	
Oxyurichthys papuensis		1	0	
Grey-barred goby on flat		1	1	
White-spotted goby		1	9	
Microdesmidae				
Gunnellichthys viridescens		1	0	
Ptereleotris heteroptera		1	3	1
Ptereleotris microlepis		1	0	
Siganidae				
Siganus puellus		1	0	
Siganus spinus		1	0	
Siganus vulpinnus		1	0	

Table 12. Continued.

Family and species	NR	P	Total	
Zanclidae				
Zanclus cornutus		1	2	
Acanthuridae				
Acanthurus blochii	?	1	2	
Acanthurus dussemieri		1	1	
Acanthurus lineatus		1	1	
Acanthurus nigricauda		1	2	
Acanthurus nigrofuscus		1	113	
Acanthurus nigoris		1	3	
Acanthurus olivaceus		1	1	
Acanthurus pyroferus		1	0	
Acanthurus thompsoni		1	3	
Acanthurus triostegus		1	0	
Acanthurus xanthopterus		1	3	
Ctenochaetus binotatus		1	2	
Ctenochaetus striatus		1	383	
Zebrasoma scopas		1	33	
Zebrasoma veliferum		1	1	
Naso lituratus		1	1	
Balistidae				
Balistapus undulatus		1	0	
Balistoides viridescens		1	0	
Rhinecanthus aculeatus			1	1
Rhinecanthus rectangulus		1	1	
Sufflamen chrysoptera		1	0	
Tetraodontidae				
Canthigaster janthinoptera		1	1	
Canthigaster solandri		1	0	
Total species		209		

and *Meiacanthus atrodorsalis* all hover in the water column adjacent to corals or soft corals. *Ostorhinchus lateralis* and *Rhabdamia cypselurus* aggregate between the branches of corals. *Chrysiptera traceyi* and *Eviota sebreei* are associated with the substrate. *Ctenochaetus striatus* swims close to the bottom, while *Spratelloides delicatulus* swims in schools in the upper water column.

Densities (number per square meter) within transects ranged from 4.1 (*Ostorhinchus lateralis,* Apogonidae) to 0.002 (several species) (Table 13). The greatest overall mean density (± standard deviation, n = 14 transects) was 0.29 (SD = 1.12) for *Ostorhinchus lateralis*, as well. This result is biased because this species was present in considerable numbers at one transect only. The goby *Eviota sebreei* (mean density = 0.08, SD = 0.1523) had the next highest density and was found in 9 of 15 transects.

Relationships between transects in the structure of respective fish assemblages are depicted in Figure 12 and Figure 13. Cluster analysis (Figure 12) indicated the existence of four major clusters. In the first, Transects 3 and 8 (the most similar, ca. 60%) were clustered with Transects 7, 11, and 13. In turn, these were clustered with Transects 4 and 9, and 10 and 14, respectively. This entire group was linked to the second cluster containing Transect 6, which then linked to Transect 15. The third cluster contained Transect 2 and Transects 1 and 12. The fourth cluster contained Transect 5 and was most similar to Transects 2, 1 and 12, but least similar to Transects 3 and 8. MDS analysis (Figure 13) indicated that Transects 3, 4, 7, 8, 9, 10, and 13 formed a highly-similar group, with habitats dominated largely by coral cover. Transects

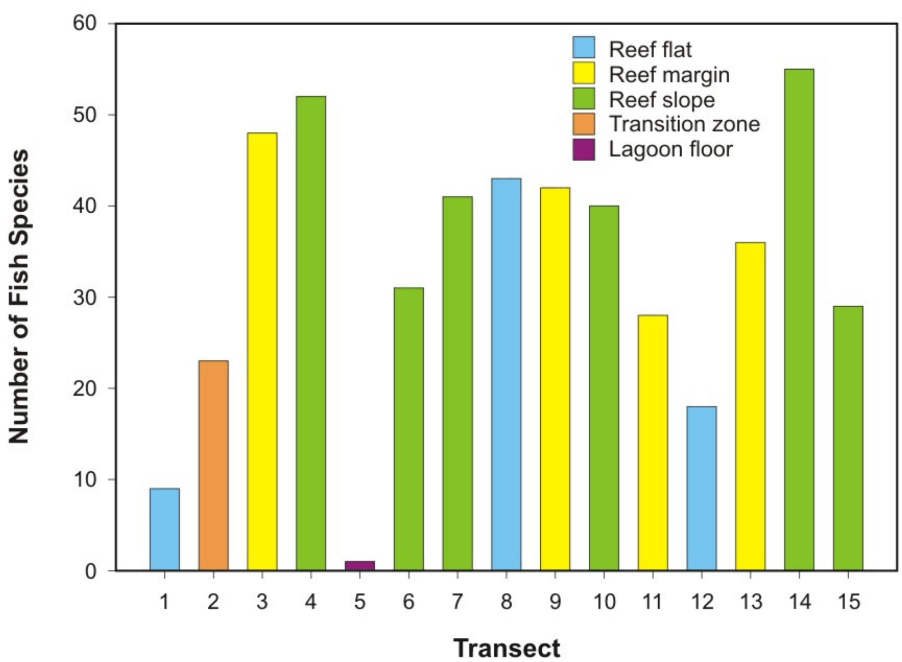


Figure 10. The total number of fish species observed on transects (n = 15) at the Pohnpei Airport runway study site.

Table 13. Densities of fishes observed on transects at the Dekehtik Island study site.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dasyatidae															
Himantura grannulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clupeidae															
Spratelloides delicatulus	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0	0
Herklotsichthys quadrimaculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synodontidae															
Saurida gracilis	0	0	0.002	0.002	0	0	0.002	0	0.002	0	0	0	0	0	0
Synodontus binotatus	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0
Synodontis variegatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mugilidae															
Crenimugil crenilabis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellochelon vaigiensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Belonidae															
Platybelone argalus platyura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiramphidae															
Hemiramphus far	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiramphus lutkei	0	0	0	0	0	0	0	0	0	0	0	0.004	0	0	0
Holocentridae															
Myrpristes adusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0.006	0
Myrpristes berndti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrpristes kuntee	0	0	0	0	0	0	0.002	0.006	0	0.002	0.002	0	0	0	0
Myrpristes murdjan	0	0	0.004	0.002	0	0	0	0.002	0	0	0.002	0	0	0	0
Neoniphon argenteus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neoniphon opercularis	0	0	0.01	0.008	0	0	0.006	0.006	0.002	0.002	0.006	0	0.006	0	0
Neoniphon sammara	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0.002
Sargocentron diadema	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0
Sargocentron spiniferum	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Fistulariidae															
Fistularia commersoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serranidae															
Cephalopholis urodeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epinephelus hexagonatus	0	0	0.002	0.002	0	0	0.004	0.004	0	0	0	0	0	0.002	0

Table 13. Continued.

Family and species	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Epinephelus maculatus	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0
Epinephelus merra	0	0.002	0.002	0	0	0.03	0	0.002	0.002	0	0	0	0	0	0
Epinephelus polyphekadion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Epinephelus spilotoceps	0	0	0	0	0	0	0.002	0	0	0	0	0	0.002	0	0
Belonoperca chabanaudi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirrhitidae															
Cirrhitichthys oxycephalus	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0	0
Paracirrhites arcatus	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0
Pseudochromidae															
Pseudochromis marshallensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apogonidae															
Apogon sangiensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apogon fragilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Archamia fucata	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0
Cheilodipterus isostigmus	0	0	0	0.024	0	0.23	0.002	0.004	0.012	0.002	0	0	0	0.004	0
Sphaeramia nematoptera	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0	0
Foa brachygramma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fowleria marmorata	2e-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostorhinchus lateralis	0	0	0	0	0	0	0	0	0	0	0	0	0	4.18	0.002
Ostorhinchus nigrofasciatus	6e-03	0.006	0	0	0	0	0	0	0	0	0	0.066	0	0	0
Rhabdamia cypselurus	0	0	0	0	0	10.03	0	0	0	0	0	0	0	0	0
Zoramia leptacantha	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
Striped coral apogon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carangidae															
Alectis indicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Caranx melampygus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gnathodon speciousus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Lutjanidae															
Lutjanus ehrenbergi	0	0	0	0	0	0	0.002	0.002	0	0	0	0	0	0	0
Lutjanus fulvus	0	0	0.008	0.002	0	0	0	0.004	0.002	0	0	0	0.002	0.002	0
Lutjanus gibbus	0	0	0	0	0	0	0	0	0	0	0	0.014	0	0	0.002
Lutjanus monostigmus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 13. Continued.

Family and species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Transect														
Lutjanus semicinctus	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0	0
Caesionidae															
Pterocaesio lativittata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterocaesio pisang	0	0	0	0	0	2.33	0	0	0	0	0	0	0	0	0.002
Haemulidae															
Plectorhinchus vittatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lethrinidae															
Gnathodentex aurolineatus	0	0	0.002	0.018	0	0	0	0.016	0.032	0.002	0	0	0.004	0.028	0
Gymnocranius euanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lethrinus harak	0	0	0.01	0	0	0	0	0	0	0	0	0.092	0	0	0
Lethrinus olivaceus	0	0	0	0	0	0	0	0	0	0	0	0.002	0	0	0
Monotaxis grandoculis	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002	0
Nempteridae															
Scolopsis lineata	0	0	0	0	0	0	0.004	0.01	0	0	0.002	0	0	0	0
Mullidae															
Mulloidichthys flavolineatus	0	0	0.002	0	0	0	0	0.002	0	0	0	0	0	0	0
Parupeneus barberinus	0	0	0.004	0	0	0	0	0	0	0.002	0	0.002	0.002	0.006	0
Parupeneus crenalabris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Parupeneus cyclostomus	0	0	0	0	0	0	0	0	0	0	0.002	0	0	0	0
Parupeneus multifasciatus	0	0	0.002	0	0	0	0	0	0	0.002	0	0	0.004	0.004	0
Chaetodontidae															
Chaetodon auriga	0	0	0	0.004	0	0	0	0	0	0	0	0.008	0	0.004	0
Chaetodon bennetti	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Chaetodon citrinellus	0	0	0	0.002	0	0	0.01	0	0.002	0	0	0	0	0	0
Chaetodon ephippium	0	0	0.004	0	0	0	0	0	0.004	0	0	0	0	0.004	0
Chaetodon kleinii	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0
Chaetodon lineolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetodon lunula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Chaetodon lunulata	0	0	0.012	0.004	0	0	0.012	0.012	0.006	0.006	0.004	0	0.016	0.012	0.004
Chaetodon melannotus	0	0	0	0.004	0	0.1	0	0.002	0	0	0	0	0	0	0
Chaetodon ornatissimus	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Chaetodon rafflesii	0	0	0	0	0	0	0	0	0.002	0	0.002	0	0.002	0	0

Table 13. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chaetodon reticulatus	0	0	0	0	0	0	0.002	0.004	0	0	0	0	0	0	0.002
Chaetodon ulietensis	0	0	0	0.002	0	0	0	0	0.004	0	0.004	0	0.002	0.002	0.004
Chaetodon vagabundus	0	0	0.008	0	0	0	0.002	0.004	0.002	0.004	0	0	0.006	0	0
Forcipinger flavissimus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heniochus acuminatus	0	0	0.006	0	0	0	0	0	0	0	0	0	0	0	0
Heniochus chrysostomus	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0.002
Heniochus varius	0	0	0	0.006	0	0.7	0	0.004	0.002	0	0	0	0	0.004	0
Pomacanthidae															
Centropyge bicolor	0	0	0	0	0	0.03	0	0	0.006	0	0	0	0	0	0
Centropyge flavissimus	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Centropyge vrolicki	0	0	0.008	0	0	0	0.002	0.016	0.002	0	0.002	0	0.006	0.002	0
Pygoplites diacanthus	0	0	0.004	0.006	0	0.03	0.002	0	0.002	0.002	0.002	0	0	0.01	0.002
Pomacentridae															
Amphiprion chrysopterus	0	0	0	0	0	0	0	0.004	0	0	0	0	0.01	0	0
Amphiprion clarki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphiprion perideraion	0	0	0	0	0	0.13	0	0	0	0	0	0	0	0	0
Chromis atripectoralis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromis margaritifer	0	0	0	0	0	0	0	0.01	0.006	0	0	0	0.006	0.002	0
Chromis scotochiloptera	0	0	0	0.012	0	0.16	0	0.016	0.026	0	0	0	0.12	0.048	0.002
Dascyllus aruanus	0	0	0	0.006	0	0	0	0	0.004	0	0	0	0	0.002	0
Dascyllus reticulatus	0	0	0	0	0	0	0	0	0.004	0	0	0	0	0	0
Dascyllus trimaculatus	0	0	0	0	0	0.07	0	0.014	0	0	0	0	0	0	0
Amblygliphididon curacao	0	0	0.192	0.148	0	0.13	0.024	0.066	0.088	0.018	0.006	0	0.214	0.032	0
Chrysiptera biocellatus	0.04	0.004	0	0	0	0	0	0	0	0	0	0.004	0	0	0
Chrysiptera cyanea	0	0.014	0.132	0.054	0	0.33	0.008	0.016	0.052	0.006	0.016	0	0.152	0.068	0.002
Chrysiptera traceyi	0	0	0.018	0.056	0	0.13	0.012	0	0.07	0.13	0.03	0	0.054	0.12	0.002
Chrysiptera sp.	0	0	0	0	0	0.1	0	0	0.002	0.016	0	0	0	0	0
Pomacentrus amboinensis	0	0	0.002	0	0	0	0	0	0	0	0	0	0.002	0.016	0.002
Pomacentrus chrysurus	0	0	0.006	0.014	0	0	0	0.01	0.012	0	0	0	0	0.004	0
Pomacentrus vaiuli	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Stegastes lividus	0	0	0.008	0	0	0	0	0	0	0	0	0	0	0	0

Table 13. Continued.

Family and species	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Labridae															
Cheilinus fasciatus	0	0	0.002	0.002	0	0	0	0.002	0	0.004	0	0	0	0.004	0.002
Cirrhilabrus katherinae	0	0	0	0	0	0.23	0	0	0	0.004	0	0	0	0.01	0
Epibulus insidiator	0	0	0	0	0	0	0	0	0	0	0	0	0	0.004	0.002
Oxycheilinus unifasciatus	0	0	0	0.002	0	0.07	0	0	0	0	0	0	0	0.002	0
Pseudocheilinus hexataenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002	0
Pterogogus cryptus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anampses meleagrides	0	0	0	0	0	0	0	0	0	0	0.002	0	0.002	0	0
Gomphosus varius	0	0	0.002	0.002	0	0	0.002	0.008	0	0	0.002	0	0	0	0
Halichoeres chlopterus	2e-03	0	0	0	0	0	0	0	0	0	0	0.004	0	0	0
Halichoeres hortulanus	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0.002	0
Halichoeres marginatus	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Halichoeres melanurus	0	0.008	0.004	0.006	0	0	0.004	0.014	0.002	0.02	0.012	0	0.03	0.014	0
Halichoeres richmondi	0	0	0	0	0	0	0.006	0	0	0.002	0	0	0	0	0
Halichoeres trimaculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemigymnus melapterus	0	0	0	0	0	0	0	0.002	0	0	0	0	0.002	0	0
Pseudocoris yamashiroi	0	0	0.002	0	0	0	0.004	0.002	0	0.002	0.002	0	0	0	0
Stethojulis strigiventer	2e-03	0	0	0	0	0.03	0.002	0	0	0	0.006	0	0	0	0
Thalassoma amblycephalum	0	0.002	0.084	0.012	0	0	0.002	0.066	0.036	0.016	0.18	0	0.032	0.112	0.002
Thalassoma hardwicke	0	0	0	0.002	0	0	0	0.004	0	0	0.002	0	0	0.004	0
Thalassoma lunare	0	0	0.004	0	0	0	0	0	0.004	0.002	0.008	0	0.004	0.006	0
Labrichthys unilineatus	0	0	0.002	0.004	0	0	0	0	0	0.004	0	0	0.002	0	0
Labroides dimidiatus	0	0.002	0.006	0.004	0	0.03	0.008	0.008	0.004	0.006	0.008	0	0.014	0.008	0
Green seagrass wrasse	0.02	0	0	0	0	0	0	0	0	0	0	0.006	0	0	0
Cheilio inermis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorurus bowersi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorurus microrhinos	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Chlorurus sordidus	0	0	0.006	0.006	0	0	0.01	0.014	0	0.052	0.006	0	0.008	0.014	0.002
Hipposcarus longiceps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptoscarus vaigiensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarus dimidiatus	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0.002	0
Scarus globiceps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 13. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Scarus psittacus	0	0	0.002	0.002	0	0	0	0	0	0.016	0	0	0.006	0.018	0
Scarus schlegeli	0	0	0	0	0	0	0	0	0.004	0	0	0	0	0.004	0
Tripterygiidae															
Ulca xenogrammus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blenniidae															
Meiacanthus atrodorsalis	0	0	0.02	0.07	0	0	0.02	0.05	0.375	0.185	0	0	0.005	0.245	0.01
Petroscirtes xestus	0	0	0	0	0	0	0	0	0	0	0	0.015	0	0	0
Plagiotremus rhynorhynchus	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
Ecsenius bicolor	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0	0
Salarias fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Callionymidae															
Callionymus simplicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0
Gobiidae															
Periophthalmus kalolo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amblyeleotris gymnocephalus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptocentrus strigilliceps	5e-03	0.035	0	0.03	0	0	0.035	0	0.01	0.01	0	0.015	0	0	0.01
Cryptocentrus sp. A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ctenogobiops aurocingulus	0	0	0	0	0	0	0	0	0	0	0	0	0	0.035	0
Amblygobius decussatus	0	0.05	0.005	0.12	0	0.03	0.11	0	0	0.19	0	0	0	0.265	0
Amblygobius hectori	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amblygobius phaelena	5e-03	0.015	0	0	0	0	0	0	0	0	0	0.005	0	0	0
Amblygobius rainfordi	0	0	0.025	0	0	0	0.025	0	0	0.065	0.005	0	0	0.075	0
Oblopomus oplopomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oxyurichthys papuensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Valenciennea strigata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asteropteryx semipunctatus	0.04	0.135	0	0	0	0	0.01	0	0	0	0	0.255	0	0.01	0
Bryaninops amplus	0	0	0	0	0	0	0	0	0	0.005	0	0	0	0	0
Coryphopterus signipinnis	0	0	0	0.005	0	0	0	0	0	0.01	0	0	0	0	0
Eviota albolineata	0	0	0	0.005	0	0	0	0	0	0	0	0	0	0	0
Eviota bifasciata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eviota prasina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eviota punctulata	0	0	0	0.05	0	0	0.02	0	0	0.025	0.005	0	0	0.005	0

Table 13. Continued.

Family and species	Transect 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eviota sebreei	0	0.055	0.055	0.065	0	0.03	0	0.095	0.025	0.23	0.545	0	0	0.045	0
Eviota sigillata	0	0.005	0.01	0	0	0	0	0	0.005	0.02	0	0	0	0.035	0
Eviota sp. B	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0.015	0
Exyrias bellissimus	0	0	0	0	0	0.06	0	0	0.015	0.005	0	0	0	0	0
Gnatholepis anjerensis	0	0.01	0	0.005	0	0	0	0	0	0.015	0	0.01	0	0	0
Gnatholepis cauerensis	0	0.045	0	0	0	0	0	0	0	0	0	0.005	0	0	0
Istigobius decoratus	0	0.03	0	0.005	0	0	0.005	0	0	0.005	0	0	0	0	0
Istigobius spence	0	0.01	0	0	0.01	0	0.01	0	0	0	0	0	0	0	0
Macrodontogobius wilburi	0	0	0	0	0	0	0.005	0	0.005	0	0	0	0	0.015	0.002
Grey-barred goby on flat	0	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0
White-spotted goby	0	0.045	0	0	0	0	0	0	0	0	0	0	0	0	0
Pinguipedidae															
Parapercis clathrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichonotidae															
Trichonotus elegans	0	0.022	0	0	0	0	0	0	0	0	0	0	0	0	0
Microdesmidae															
Gunnellichthys viridescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptereleotris heteroptera	0	0	0	0	0	0	0	0	0	0	0	0	0.006	0	0
Ptereleotris microlepis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siganidae															
Siganus puellus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Siganus spinus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siganus vulpinnus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zanclidae															
Zanclus cornutus	0	0	0.002	0	0	0.03	0	0	0	0	0	0	0	0	0
Acanthuridae															
Acanthurus blochii	0	0	0	0	0	0	0	0	0	0	0	0.004	0	0	0
Acanthurus dussemieri	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0	0
Acanthurus lineatus	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0
Acanthurus nigricauda	0	0	0.002	0	0	0.03	0	0	0	0	0	0	0	0	0
Acanthurus nigrofuscus	0	0.008	0.04	0.026	0	0.03	0.064	0.04	0.002	0	0.032	0	0	0.012	0
Acanthurus nigoris	0	0	0	0	0	0	0.002	0.004	0	0	0	0	0	0	0

Table 13. Continued.

Family and species	Transect														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Acanthurus olivaceus	0	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0
Acanthurus pyroferus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acanthurus thompsoni	0	0	0	0	0	0	0	0	0.002	0	0	0.002	0	0.002	0
Acanthurus triostegus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acanthurus xanthopterus	0	0	0.002	0	0	0.03	0.002	0	0	0	0	0	0	0	0
Ctenochaetus binotatus	0	0	0	0	0	0.03	0	0	0	0	0	0	0.002	0	0
Ctenochaetus striatus	0	0.062	0.094	0.036	0	0.1	0.136	0.092	0	0.012	0.094	0	0.186	0.048	0
Zebrasoma flavescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zebrasoma scopas	0	0	0.004	0.006	0	0	0.002	0.014	0	0.002	0	0	0.036	0.002	0
Zebrasoma veliferum	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0	0.002
Naso lituratus	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0
Balistidae															
Balistapus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.002
Balistoides viridescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinecanthus aculeatus	0	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinecanthus rectangulus	0	0	0	0	0	0	0	0	0	0	0	0.002	0	0	0
Sufflamen chrysoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetraodontidae															
Canthigaster janthinoptera	0	0	0	0.002	0	0	0	0	0	0	0	0	0	0	0
Canthigaster solandri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

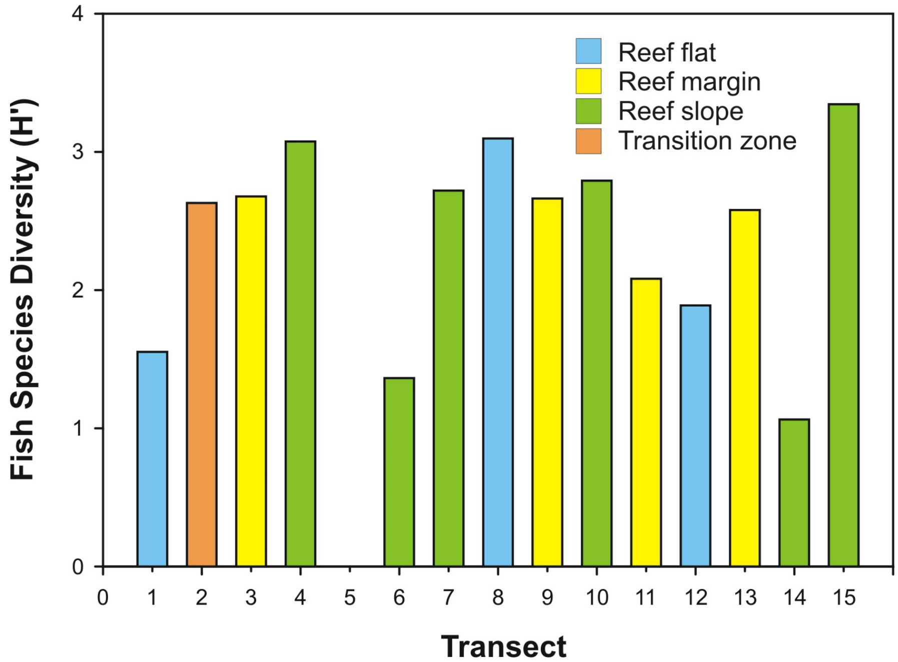


Figure 11. Fish species diversity (Shannon index, H') at each of 15 transects at the Pohnpei Airport runway study site. Greater diversity is indicated by higher values of H'.

1 and 12 were quite similar to one another (both reef flats with sea grasses) and formed a second group, while Transects 5 (mud), 6 (coral knoll surrounded by mud) and 2 (coral boulders) were most dissimilar. A stress level of 0.06 is indicative of a reasonably high level of significance in the relationships represented.

Overall, the reef fish assemblages within the transects at the study site were relatively depauperate and dominated by a few species. In a study made prior to the previous expansion of the runway, 127 species in 68 genera and 26 families were recorded from within the study area (Trans Asia Engineering, 1977). Greater diversity and species richness associated with increased habitat complexity. Transects with essentially uniform habitat structure (i.e., mud and silt at Transect 5) had low species richness and diversity. Turbidity, although not measured, is also likely a factor affecting the assemblage structure of fishes in the study area (see Trans Asia Engineering, 1977). Transects with relatively low turbidity tended to have greater numbers of species and individuals compared to transects that had poor visibility because of turbid conditions (personal observation). Some species (i.e., *Chrysiptera cyanea*, Pomacentridae),

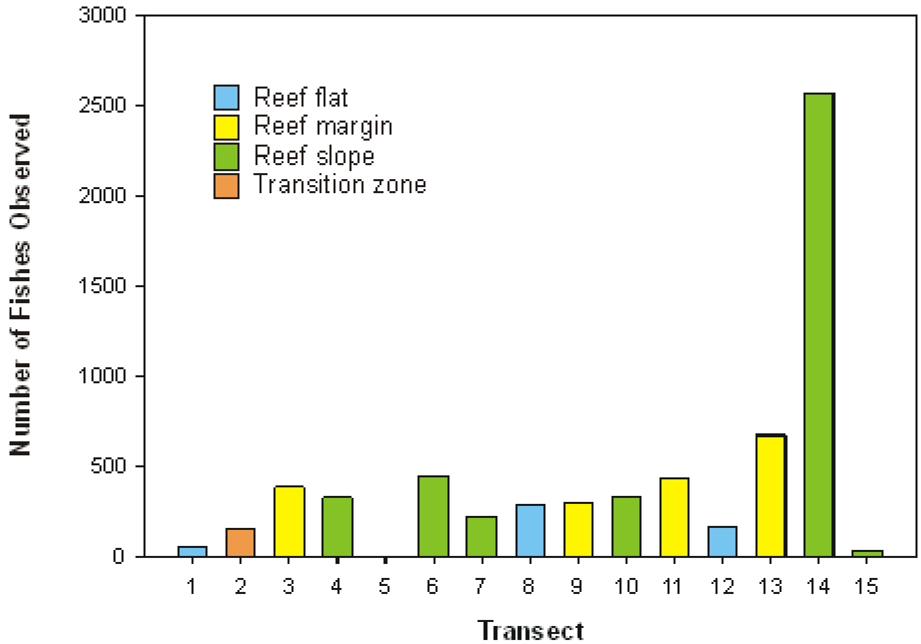


Figure 12. Total number of individual fishes (all species) observed on transects (n = 15 transects) at the Pohnpei Airport runway study site.

however, seemed to do well in turbid conditions provided that some form of physical structure, either a coral head or large rock, was present to provide shelter.

Small bodied species, such as the cardinalfishes *Ostorhinchus lateralis* and *Rhabdamia cypselurus*, constituted the majority of fishes observed as these were limited to just a few transects where coral cover was well developed. Damselfishes, especially *Amblygliphididon curacao*, *Chrysiptera cyanea*, and *Chrysiptera traceyi*, were also relatively abundant, as was a small wrasse (Labridae), *Thalassoma amblycephalum*, and certain gobies (Gobiidae), such as *Amblygobius decussatus* and *Eviota sebreei*, as well as the blenny (Blenniidae) *Meiacanthus atrodorsalis*. Larger-sized food fishes, with the exception of the surgeonfishes (Acanthuridae) *Ctenochaetus striatus* and *Acanthurus nigrofuscus* (both relatively small in size), the parrotfish (Labridae: Scarinae) *Chlororus sordidus*, were relatively rare and often represented mainly by juveniles or small-sized adults (i.e., *Lutjanus fulvus* and *Lutjanus gibbus*) on or adjacent to reef flats. Trans Asia Engineering (1977) reported low diversity of both food and non-food fish

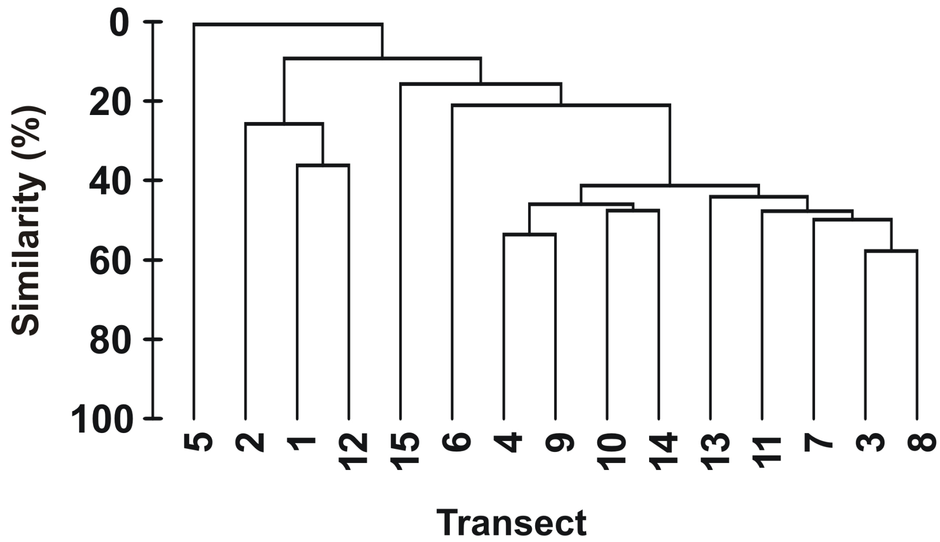


Figure 13. Cluster analysis (group averaging) of reef fish assemblage relationships between transects at the Pohnpei Airport Runway study site. Values of similarity (0 to 100%) were calculated in pair-wise comparisons with the Bray-Curtis similarity index and then assembled in a matrix prior to cluster analysis.

species on transects conducted in this area, and that both diversity and the number of individuals were greater at transects located on reef slopes, reef margins, and in dredged areas, while juveniles were most often seen on reef flats. This report suggested that dredging activities would actually increase the diversity and abundance of food fish species, but this remains to be examined.

The reef fish assemblages in habitats at transects within the study area seem typical of a lagoons and, as both cluster and MDS analyses indicate, were largely similar to on another except when the habitats were dominated by sea grasses or by mud. Some of these transects have a number of species that are specialized for corals (i.e., cardinalfishes, Apogonidae), rubble and soft sediments (i.e, gobies, Gobiidae), and seagrasses (i.e., gobies; juvenile snappers, Lutjanidae). Dredging and filling activities in this area will likely have negative impacts upon these kinds of fishes although to what extent cannot depends upon the magnitude of the activities in question.

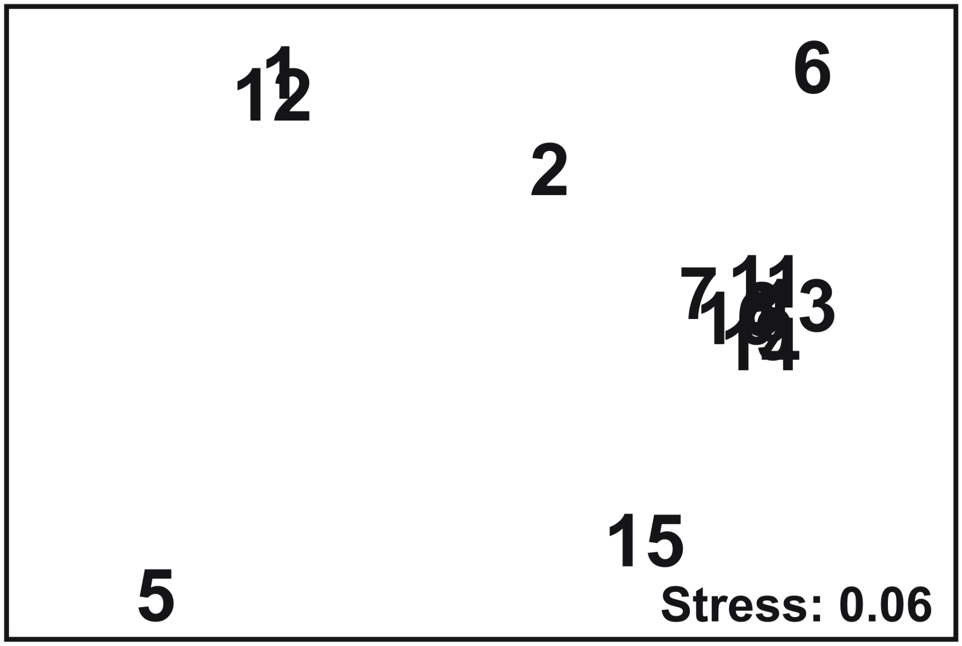


Figure 14. Multidimensional Scaling (MDS) analysis of reef fish assemblage relationships between sampling stations at the Pohnpei airport runway study site.

SUMMARY

The marine flora and fauna of the primary survey area east of Dekehtik Island (Reefs A, B, and C) were typical of a protected, inner lagoon reef system. Although the coral reef communities in this part of the lagoon are generally considered depauperate, similarities in the results reported in the present survey and a previous survey performed 29 years ago indicate that these communities are quite stable and well adapted to stressful conditions of high turbidity, sedimentation, and fluctuating salinity.

The coral fauna in the study area consisted of 85 species. The most common corals were massive *Porites* spp. that were up to 2 m in diameter. Although acroporid corals comprised 22% of the species encountered in the survey area, they often occurred only as individual colonies and contributed negligibly to cover and biomass. Several genera that are tolerant of turbid environments were quite common at Dekehtik, commonly inhabiting the lower reef slopes. There was considerable variation in species richness, coverage, and population density of corals from one transect to another, possibly because of differences in physiographic environments sampled. The lower reef slopes and lagoon floor are covered by fine-grained sediments that preclude settlement by coral larvae.

Marine plants and macroinvertebrates were only moderately diverse. Species richness of marine plants declined with depth, probably because of high turbidity. Twenty-six species of marine algae and three species of seagrasses were observed in the study area. Macroinvertebrate assemblages were dominated by suspension-feeding species, which comprised some 57% of the 89 species identified in the study area. Reef slope communities supported the greatest number of macroinvertebrates species. Coral-associated macroinvertebrates were widely distributed and abundant in the study area.

The fish fauna totaled 209 species that are characteristic of an inner lagoon reef system. Like the macroinvertebrates, many fish species lived in close proximity to corals. Unlike the other taxa, the ichthyofauna included species that inhabit the lower reef slopes and lagoon floor, particularly burrowing species associated with alpheid shrimps. Overall, none of the fish species observed is likely to be limited in local distribution to this locality alone, but they are expected to occur at other, comparable sites within Pohnpei's lagoon system. No endangered or threatened species were observed during the survey.

RECOMMENDATIONS

If the decision is made to extend the Pohnpei International Airport runway by filling in the reef area east of Dekehtik Island, the following recommendations should be given consideration.

1. **Before construction is started, a marine biological survey is needed to establish a baseline for monitoring effects of construction on coral reef areas adjacent to the construction area and downstream in prevailing currents.**

   Benthic communities on Transects 1, 2, 3, 4, 5, 6, 7, 8, 9, and 15 in reefs designated A and C in this study (Figure 5) will be destroyed by filling for the runway extension. The environmental impacts of dredging and filling upon adjacent reefs and reefs down current can be assessed only if reference ecological and biological baseline data are available before construction is started. Current studies indicate that currents near the construction area flow in a northerly direction (Japan Airport Consultants, Inc., 2005), and they flow in a northwesterly direction towards the Main Channel [= Ponape Passage] in the lagoon just north of the construction site (Trans Asia Engineering, 1977; Pendleton, 1980). Therefore, transect studies should be completed on reefs designated D and E in this study, as well as lagoon reefs between Dekehtik Island and the Main Passage through the barrier reef. Particular attention should be given to reef communities in the marine reserve at Sapwtik Island.

2. **Floating silt curtains, extending from the surface to the lagoon floor, should be placed completely around all dredge and fill sites, and silt curtains should be routinely monitored and maintained to contain silt produced by construction.**

   Dredge and fill operations produce large quantities of fine silt particles suspended in the water column. Sedimentation is a significant problem for coral reefs surrounding high islands or in coastal areas of continents. Sediments may have an energetic cost to the coral that must cleanse its surface, resulting in slower growth rates and in less energy available for reproduction (Tomascik and Sander, 1987; Wolanski et al., 2003). Sediments can also interfere with larval recruitment on coral reefs by interfering with the chemosensory ability of coral larvae seeking the appropriate chemical signals from preferred settlement substrates, such as coralline algae (Richmond, 1997). Silt curtains can be effective in confining suspended sediments when properly deployed and maintained.

3. **All dredge and fill operations should be suspended during the period of the annual coral spawning event in Pohnpei waters.**

Some 85% of reef-building corals are spawners, i.e., reproduction occurs after the release of gametes into the water, where fertilization takes place (Richmond, 1997). Multispecies mass-spawning events occur during limited periods each year. To maximize reproductive success, most spawning species release their gametes over a 5–8-day period that is related to the lunar cycle. Studies in Guam revealed that peak spawning occurs 7–10 days after the full moon in July (Richmond and Hunter, 1990). Based on the latitudinal differences between Guam and Pohnpei, it is likely that coral spawning in Pohnpei occurs in June and July, but spawning could occur as early as March, April, and May, as it does in Palau (Kenyon, 1995). Because suspended sediments may interfere with egg-sperm interactions in the fertilization process (Richmond, 1987; Wolanski et al., 2003), dredge and fill operations can affect coral reproduction on reefs far downstream of the actual construction activities. In Guam, U.S. Army Corps of Engineers permits for maintenance dredging of the Naval Base require that dredging operations cease during annual coral spawning periods (M.E. Guarin, P.E., Construction Management Engineer, NAVFAC OICC Marianas, personal communication, April 27, 2004). Therefore, similar measures should be adopted for construction of the Pohnpei Airport runway extension.

4. **Marine biological communities should be monitored throughout the construction of the airstrip extension.**

The construction of airstrip extensions on small, tropical islands usually requires dredge and fill operations in coral reef environments. Monitoring studies have shown that precautions for environmental protection can limit the effects of airport runway construction on nearby marine communities. Amesbury et al. (1982) identified few measurable effects related to construction of the airport runway extension at Weno Island, Chuuk [= Moen Island, Truk]. However, these authors reported that fluctuations in species richness, percent cover, and population density of several taxa occurred during the construction period. Where siltation was heaviest, the decline in coral coverage was significant, and no evidence of new coral recruitment was found one year after the completion of runway construction. Marine plants, macroinvertebrates, and reef fishes also declined at those monitoring stations that were inundated with sediments. If construction of the Pohnpei Airport extension proceeds, those reefs down-current of dredge and fill operations should be monitored regularly so that any damage to coral communities caused by sedimentation from runway construction can be identified promptly and so that the necessary measures can be taken to minimize any damage. Monitoring intervals should be semi-annual, if possible.

REFERENCES CITED

Amesbury, S.S., R.T. Tsuda, R.H. Randall, and C.E. Birkeland. 1977. Marine Biological Survey of the Proposed Dock Site at Colonia, Yap, Western Caroline Islands. University of Guam Marine Laboratory, Technical Report 35:1–22.

Amesbury, S.S., J.A. Marsh, Jr., R.H. Randall, and J.O. Stojkovich. 1977. Limited Current and Underwater Biological Survey of Proposed Truk Tuna Fishery Complex Dublon Island, Truk, Western Caroline Islands. University of Guam Marine Laboratory, Technical Report 36:1–49.

Amesbury, S.S., R.N. Clayshulte, G.R. Grimm, and G. Plucer-Rosario. 1982. Biological Monitoring Study of Airport Runway Expansion Site, Moen, Truk, Eastern Caroline Islands. University of Guam Marine Laboratory, Technical Report 81:1–70.

Birkeland, C., editor. 1980. Marine Biological Survey of Northern Ponape Lagoon. University of Guam Marine Laboratory, Technical Report 62:1–102.

Clarke, K.R., and R.N. Gorley. 2001. PRIMER, v5. PRIMER-E, Ltd, Plymouth, England, 91 pages + software.

Cottam, G., J.T. Curtis, and B.W. Hale. 1953. Some sampling characteristics of a population of randomly dispersed individuals. Ecology 34:741–757.

Dickinson, R.E. 1977. The occurrence and natural habitat of the mangrove crab, *Scylla serrata* (Forsskål), on Ponape and Guam. 71 pages.

Eldredge, L.G. 1980. Bibliography of coastal Ponape. Pages 77–94 in C. Birkeland, editor. Marine Biological Survey of Northern Ponape Lagoon. University of Guam Marine Laboratory, Technical Report 62.

Kenyon, J.C. 1995. Latitudinal differences between Palau and Yap in coral reproductive synchrony. Pacific Science 49:156–164.

McDermid, K., and A. Edward. 1999. Seagrass community composition and biomass at Nahpali Island, Pohnpei. Micronesica 31:255–262.

Myers, R.F. 1999. Micronesian Reef Fishes, 3rd ed. Coral Graphics, Barrigada, Guam. 330 pages + 192 plates.

Japan Airport Consultants, Inc. 2005. The Study on the Improvement of Pohnpei International Airport in the Federated States of Micronesia: Progress Report (Draft). Nippon Koei Co., Ltd.

Pendleton, D. 1980. Current patterns in the northern lagoon of Ponape. Pages 7–25 in C. Birkeland, editor. Marine Biological Survey of Northern Ponape Lagoon. University of Guam Marine Laboratory, Technical Report 62.

Randall, R.H., and D. Pendleton. 1980. Mapping of the reef habitat types on northern Ponape. Pages 27–42 in C. Birkeland, editor. Marine Biological Survey of Northern Ponape Lagoon. University of Guam Marine Laboratory, Technical Report 62.

Randall, J.E. 2005. Reef and Shore Fishes of the South Pacific— New Caledonia to Tahiti and the Pitcairn Islands. University of Hawaii Press, Honolulu. 707 pages.

Richmond, R.H. 1997. Reproduction and recruitment in corals: Critical links in the persistence of reefs. Pages 175–197 in C. Birkeland, editor. Life and Death of Coral Reefs. Chapman & Hall, New York.

Richmond, R.H., and C.L. Hunter. 1990. Reproduction and recruitment of corals: Comparisons among the Caribbean, the tropical Pacific, and the Red Sea. Marine Ecology Progress Series 60:185–203.

Smalley, T. 1980. Common crustaceans, mollusks, and echinoderms of northern Ponape Lagoon. Pages 61–66 in C. Birkeland, editor. Marine Biological Survey of Northern Ponape Lagoon. University of Guam Marine Laboratory, Technical Report 62.

SPSS, Inc. 1999. SigmaScan Pro 5.0 image analysis software. Chicago, Illinois.

Tomascik, T., and F. Sander. 1987. Effects of eutrophication on reef-building corals. III. Reproduction of the reef-building coral *Porites porites*. Marine Biology 94:77–94.

Trans Asia Engineering. 1977. Environmental impact assessment report for Ponape International Airport. 381 pages.

Tsuda, R.T. 1972. Morphological, zonational, and seasonal studies on two species of *Sargassum* on the reefs of Guam. Proceedings of the Seventh International Seaweed Symposium, Sapporo, Japan:40–44.

Tsuda, R.T., R.H. Randall, and J.A. Chase. 1974. Limited Current and Biological Study in the Tuanmokot Channel, Ponape. University of Guam Marine Laboratory, Technical Report 15:1–58.

U.S. Army Corps of Engineers. 1986. Pohnpei Coastal Resource Inventory. U.S. Army Engineer Division, Pacific Ocean, Fort Shafter, Hawaii. 170 pages.

Veron, J.E.N. 2000. Corals of the World. Volumes 1, xii + 463 pages. Volume 2, viii + 429 pages. Volume 3, viii + 490 pages. Australian Institute of Marine Science, Townsville, Queensland, Australia.

Westneat, M.W., and M.E. Alfaro. In press. Phylogenetic relationships and evolutionary history of the reef fish family Labridae. Molecular Phylogenetics and Systematics.

Wallace, C.C. 1999. Staghorn Corals of the World: A Revision of the Genus *Acropora*. CSIRO Publications, Melbourne, Victoria, Australia.

Wolanski, E., R. Richmond, L. McCook, & H. Sweatman. 2003. Mud, marine snow and coral reefs. American Scientist 91:44–51.

PLATES

Plates I–XVII, Coral Species

Plates XVIII–XXVI, Coral Communities

PLATE I

A. *Acropora acuminata*. Reef C, near Transect 15, reef slope, 2 m.

B. *Acropora caroliniana*. Reef A, near Transect 4, reef slope, 4 m.

C. *Acropora cytherea*. Transect 6, coral knoll, 7.5 m.

D. *Acropora cytherea*, detail view. Transect 6, coral knoll, 7.5 m.

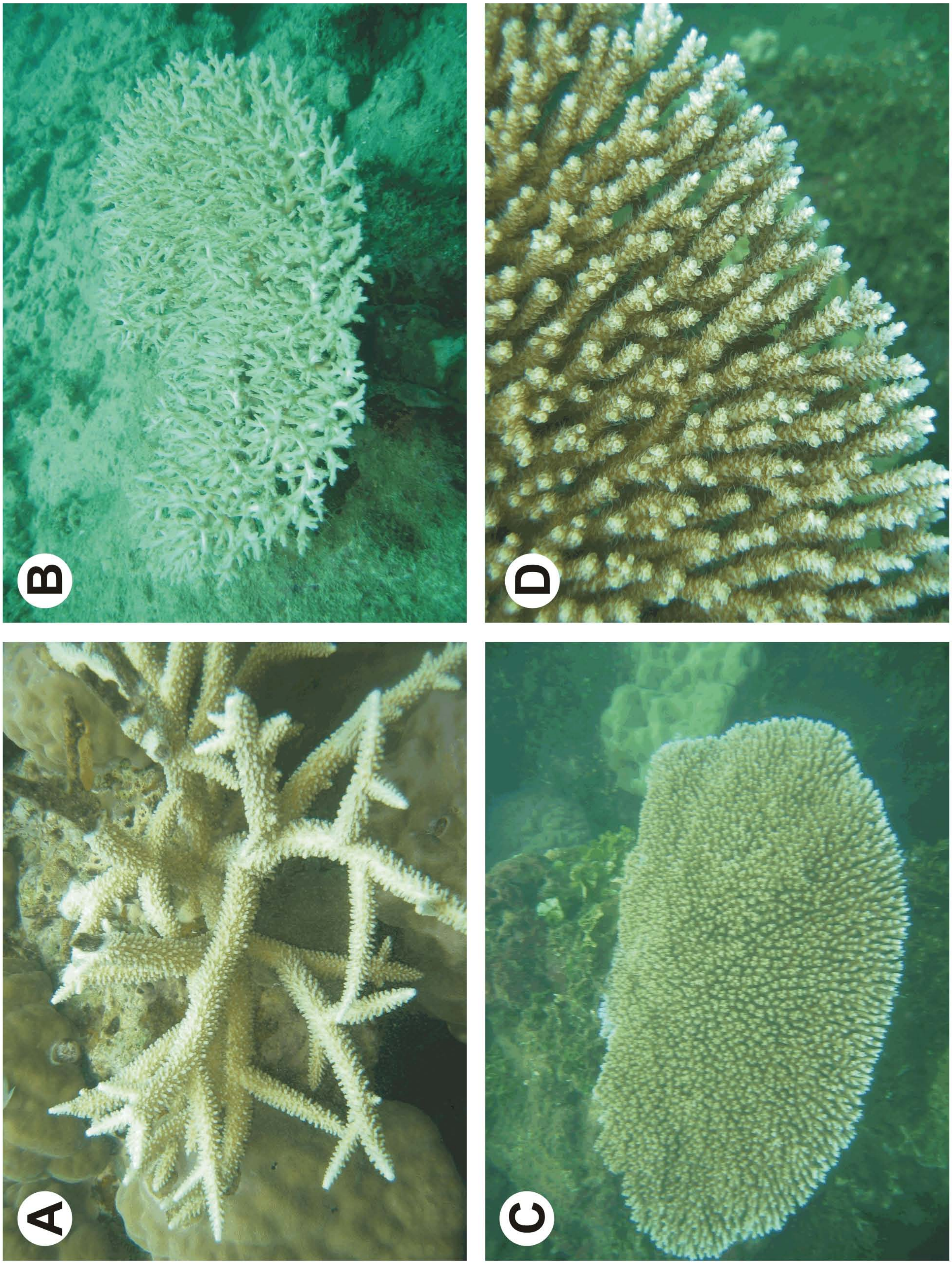

B
D
A
C

PLATE II

A. *Acropora clathrata*. Near Transect 4, reef slope, 8 m.

B. *Acropora echinata*. Near Transect 4, reef slope, 9 m.

C. *Acropora echinata*. Near Transect 4, reef slope, 9 m.

D. *Acropora muricata*. Near Transect 4, reef slope, 9 m.

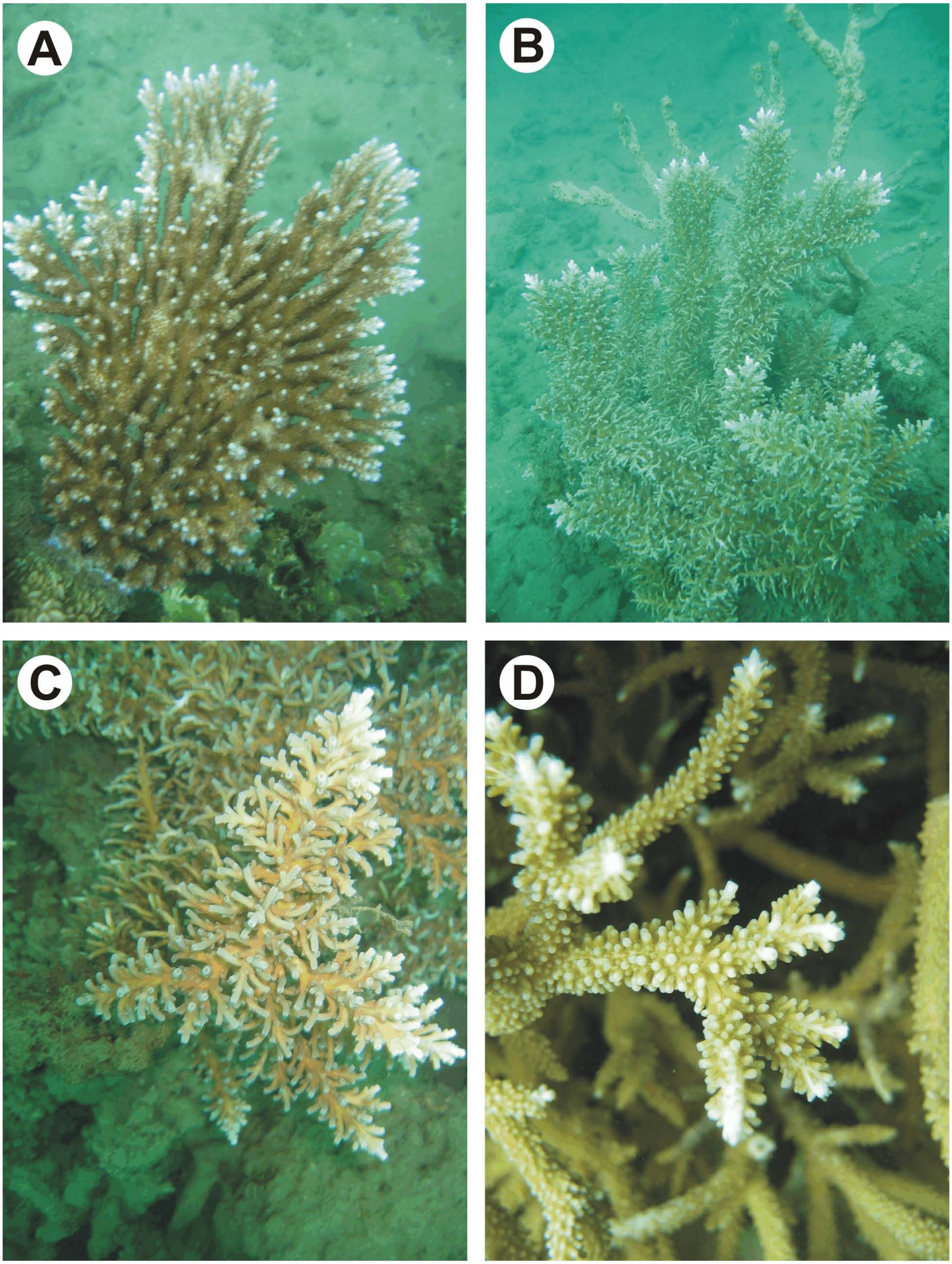

A
B
C
D

PLATE III

A. *Acropora nasuta*. Near Transect 3, reef margin, 2 m.

B. *Acropora tenuis*. Near Transect 4, reef slope, 9 m.

C. *Acropora tenuis*. Near Transect 4, reef slope, 9 m.

D. *Acropora valida*. Near Transect 3, reef margin, 2 m.

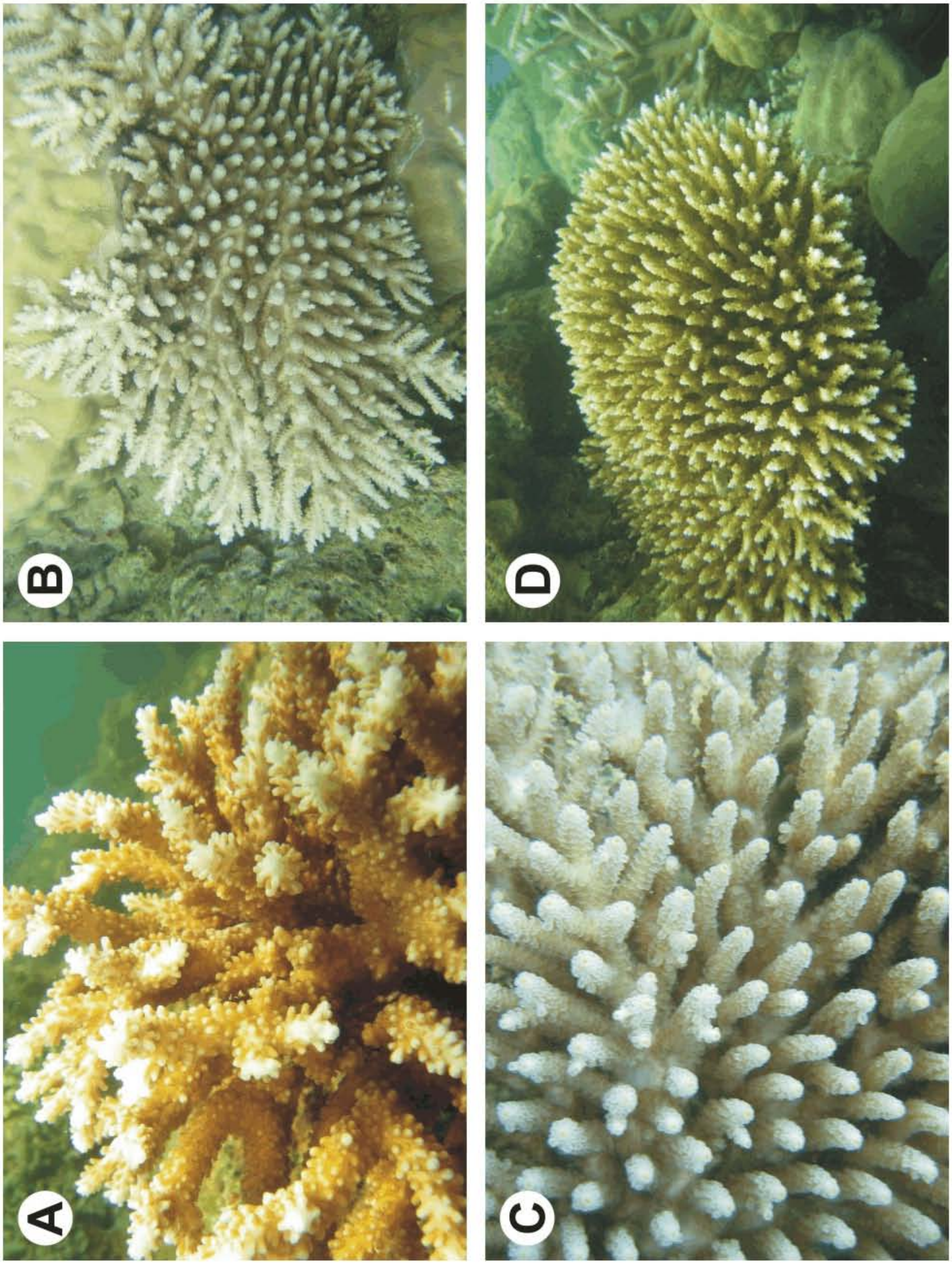

A
B
C
D

PLATE IV

A. *Acropora* sp. 1. Near Transect 7, reef slope, 7 m.

B. *Acropora* sp. 2. Near Transect 8, reef margin, 2 m.

C. *Acropora* sp. 3. Near Transect 7, upper reef slope, 4 m.

D. *Acropora* sp. 4. Near Transect 7, upper reef slope, 4 m.

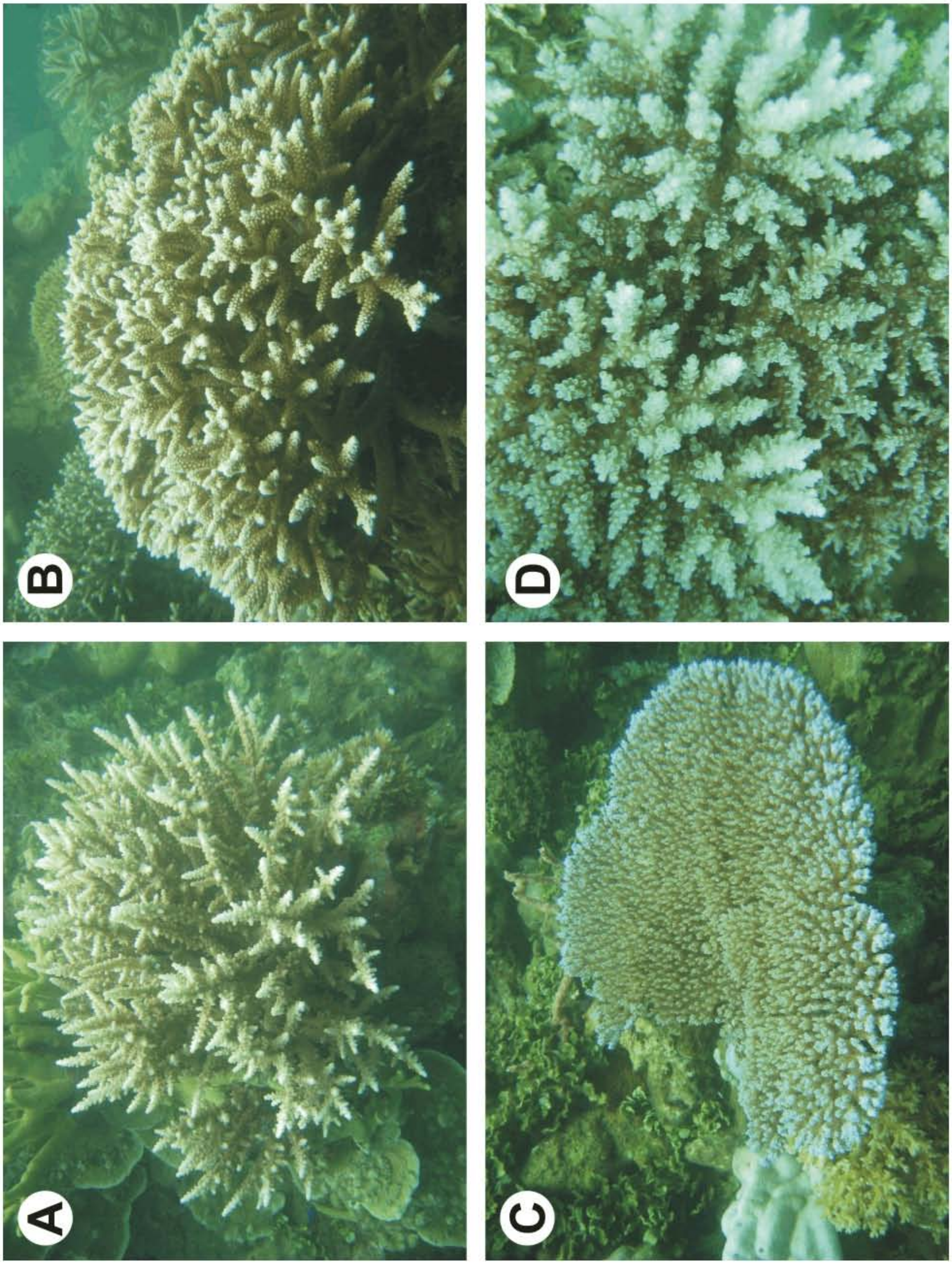

A
B
C
D

PLATE V

A. *Acropora* sp. 5. Transect 2, transition zone, 2 m.

B. *Astreopora myriophthalma*. Transect 2, transition zone, 2 m.

C. *Montipora digitata*. Near Transect 15, reef margin, 1 m.

D. *Montipora turgescens*. Near Transect 15, reef slope, 4 m.

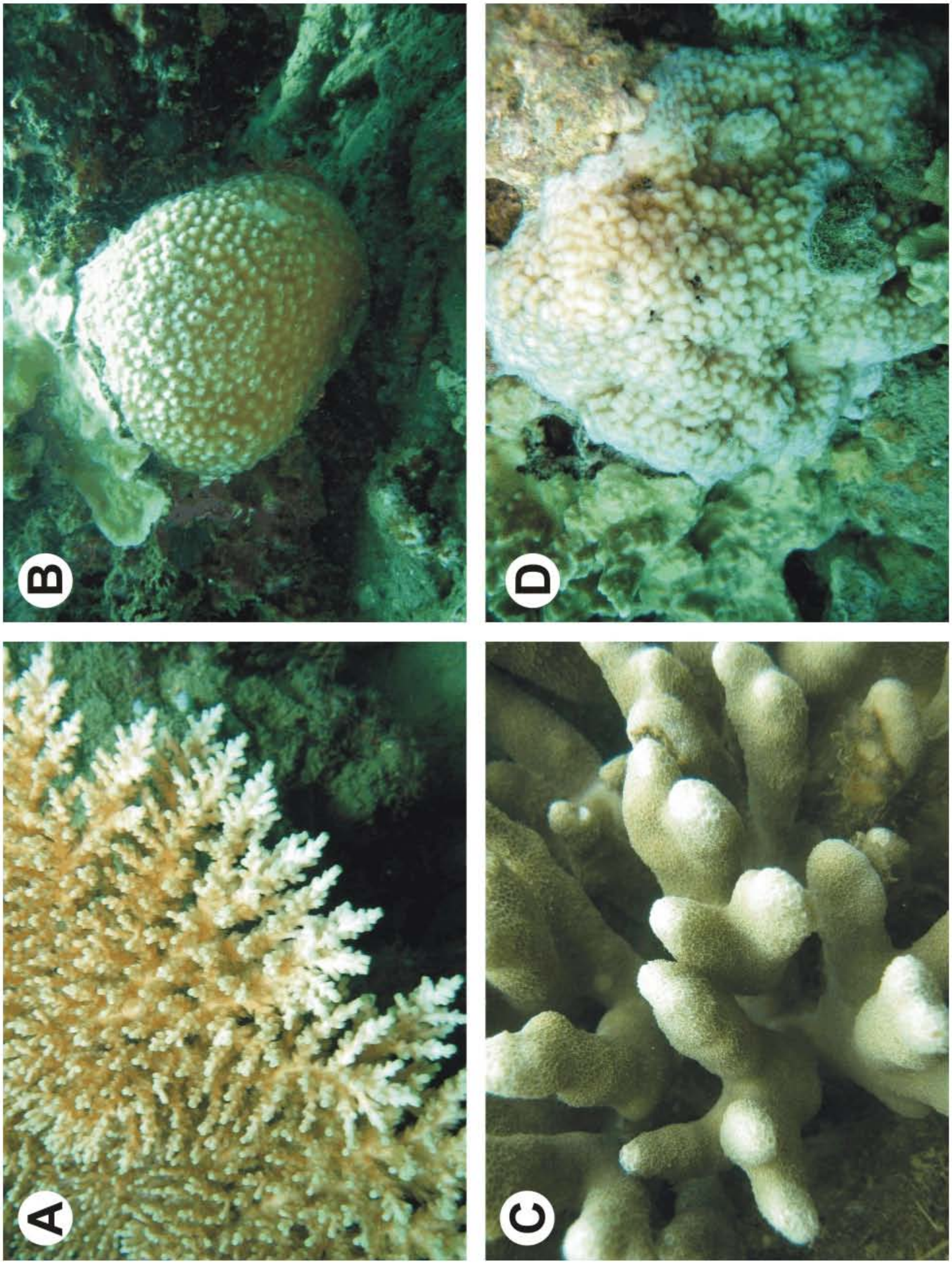

A
B
C
D

PLATE VI

A. *Montipora verrucosa*. Near Transect 15, reef slope, 4 m.

B. *Pavona cactus*. Near Transect 6, coral knoll, 8 m.

C. *Pavona varians*. Near Transect 6, coral knoll, 8 m.

D. *Pachyseris rugosa*. Near Transect 15, upper reef slope, 3 m.

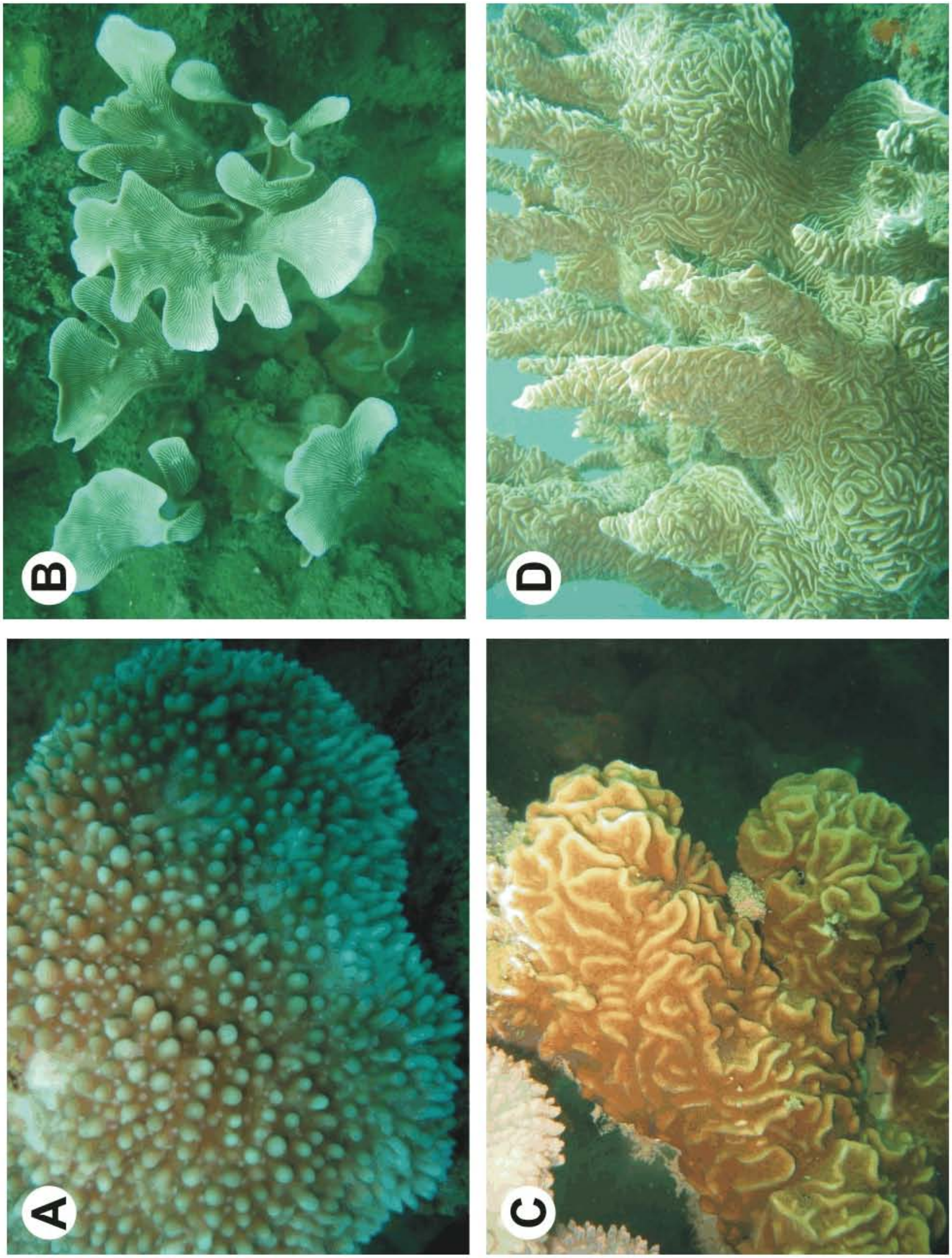

A
B
C
D

Plate VII

A. *Pachyseris speciosa*. Near Transect 6, reef slope, 9 m.

B. *Gardineroseris planulata*. Near Transect 15, reef slope 3 m.

C. *Turbinaria reniformis*. Near Transect 15, reef slope, 3 m.

D. *Euphyllia glabrescens*. Near Transect 6, reef slope, 9 m.

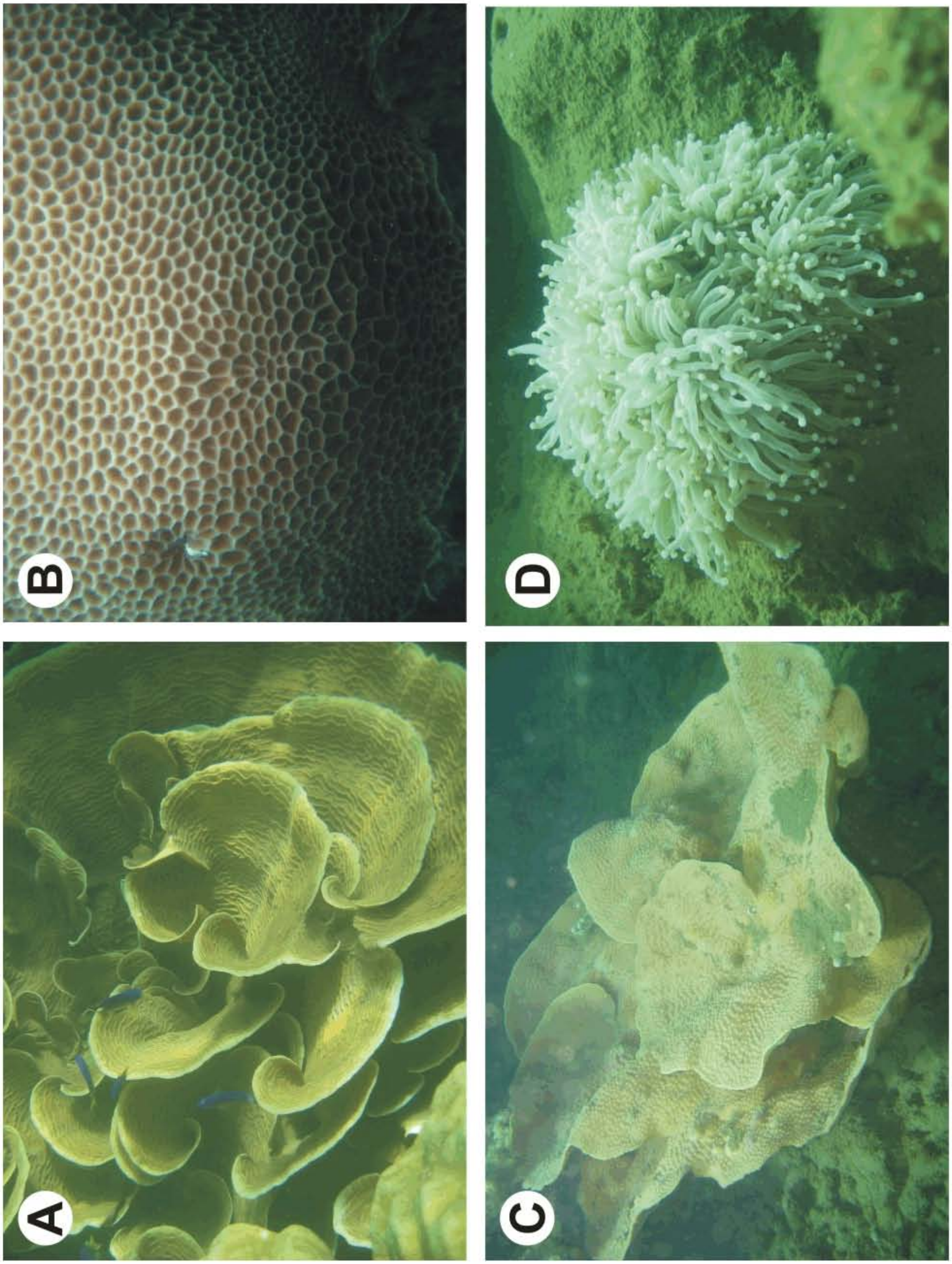

B
D
A
C

PLATE VIII

A. *Euphyllia paraancora*. Near Transect 3, reef margin, 1 m.

B. *Plerogyra sinuosa*. Near Transect 15, upper reef slope, 3 m.

C. *Physogyra lichtensteini*. Near Transect 15, reef slope, 5 m.

D. *Diploastrea heliopora*. Near Transect 15, reef slope, 4 m.

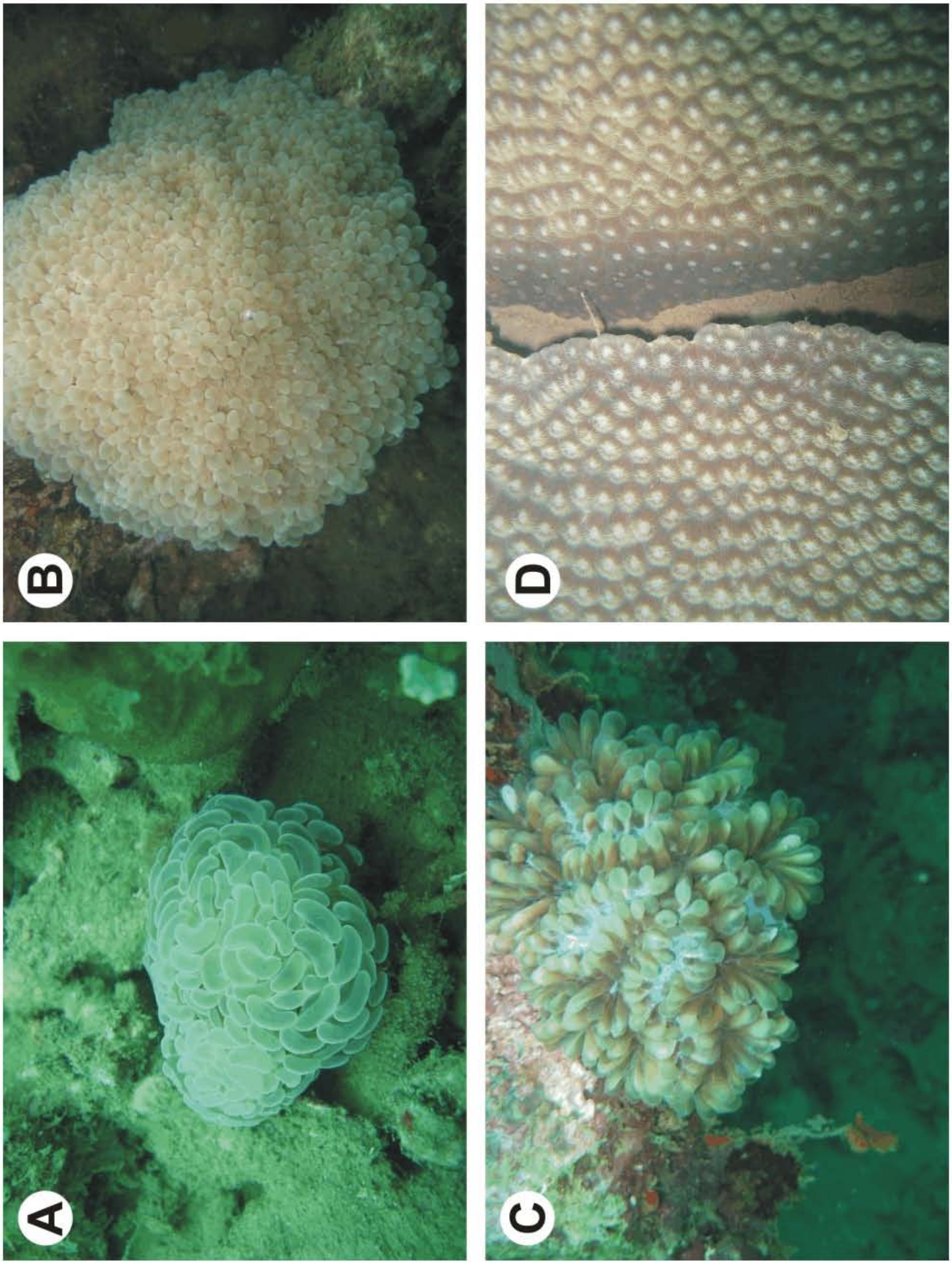

B
D
A
C

PLATE IX

A. *Favia matthai*. Near Transect 10, reef slope, 5 m.

B. *Favia pallida*. Near Transect 15, upper reef slope, 3 m.

C. *Favites complanata*. Near Transect 3, upper reef slope, 3 m.

D. *Goniastrea pectinata*. Transect 10, reef slope, 4 m.

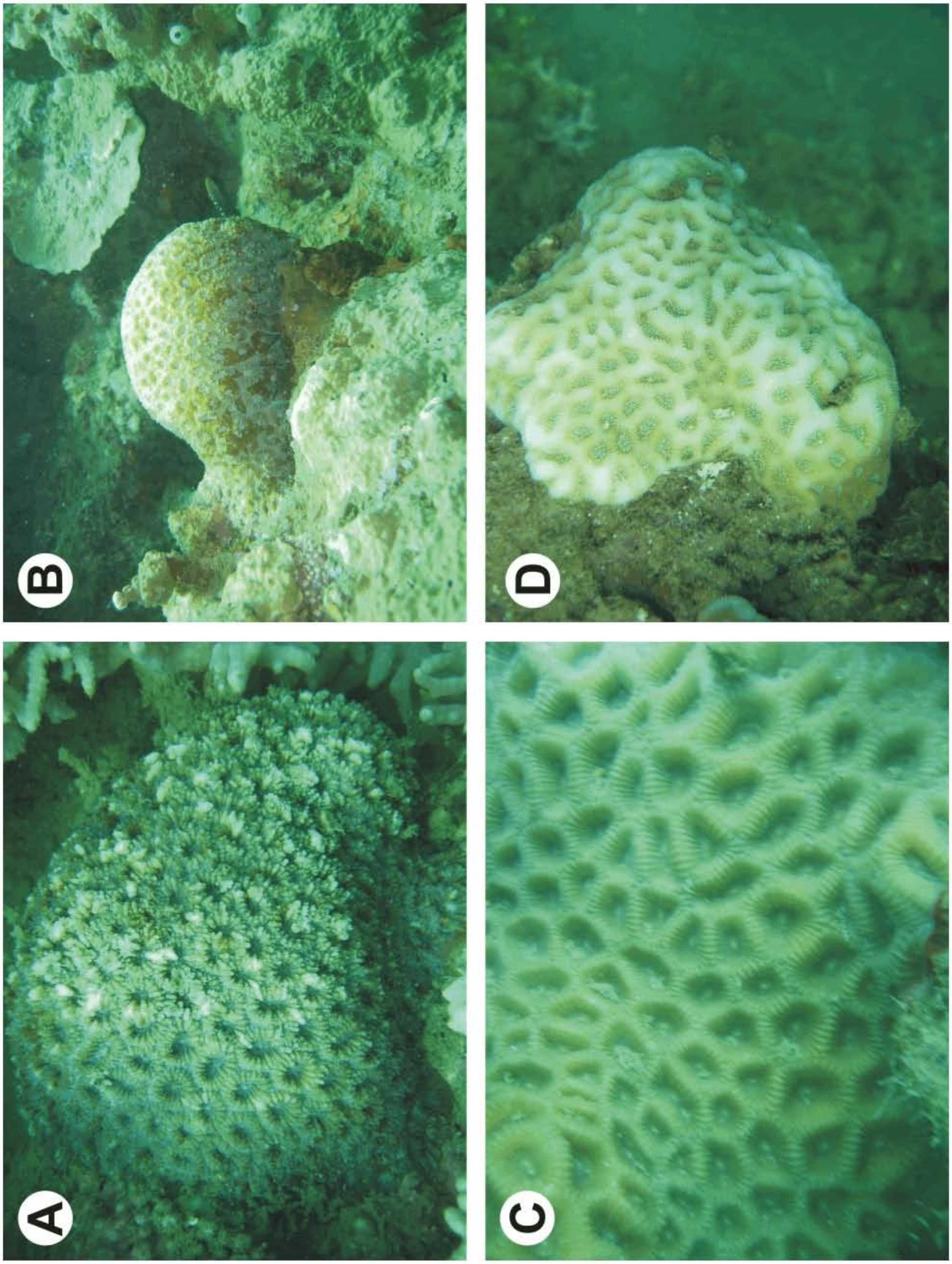

A
B
C
D

PLATE X

A. *Leptastrea purpurea*. Near Transect 15, reef margin, 2 m.

B. *Montastrea curta*. Transect 4, reef slope, 4 m.

C. *Platygyra daedalea*. Transect 2, transition zone, 2 m.

D. *Platygyra pini*. Transect 4, reef slope, 3 m.

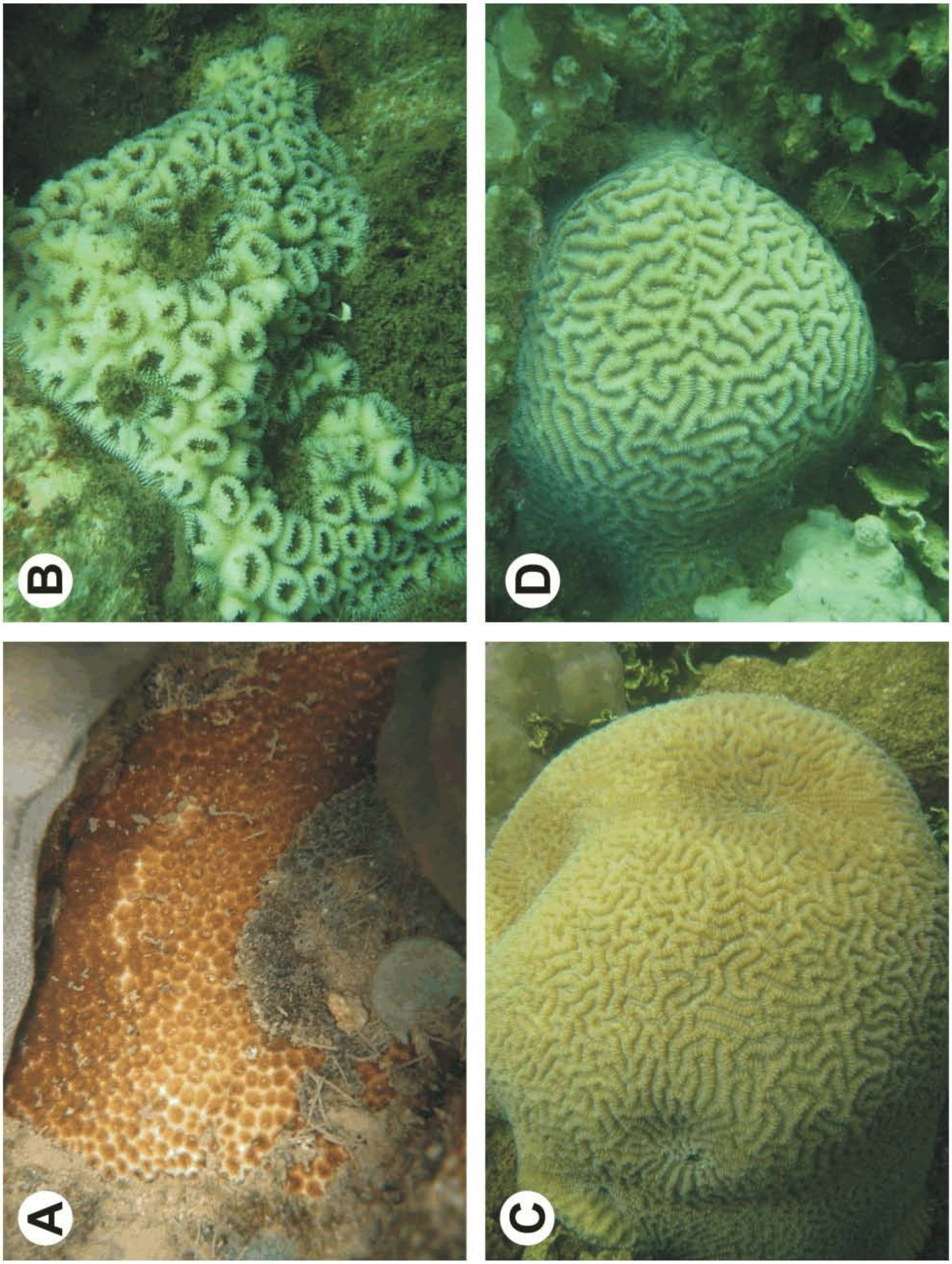

B
D
A
C

Plate XI

A. *Ctenactis crassa*. Transect 7, reef slope, 9 m.

B. *Cycloseris* sp. Transect 14, reef slope, 4 m.

C. *Fungia fungites*. Near Transect 4, upper reef slope, 3 m.

D. *Fungia repanda*. Near Transect 7, reef slope, 4 m.

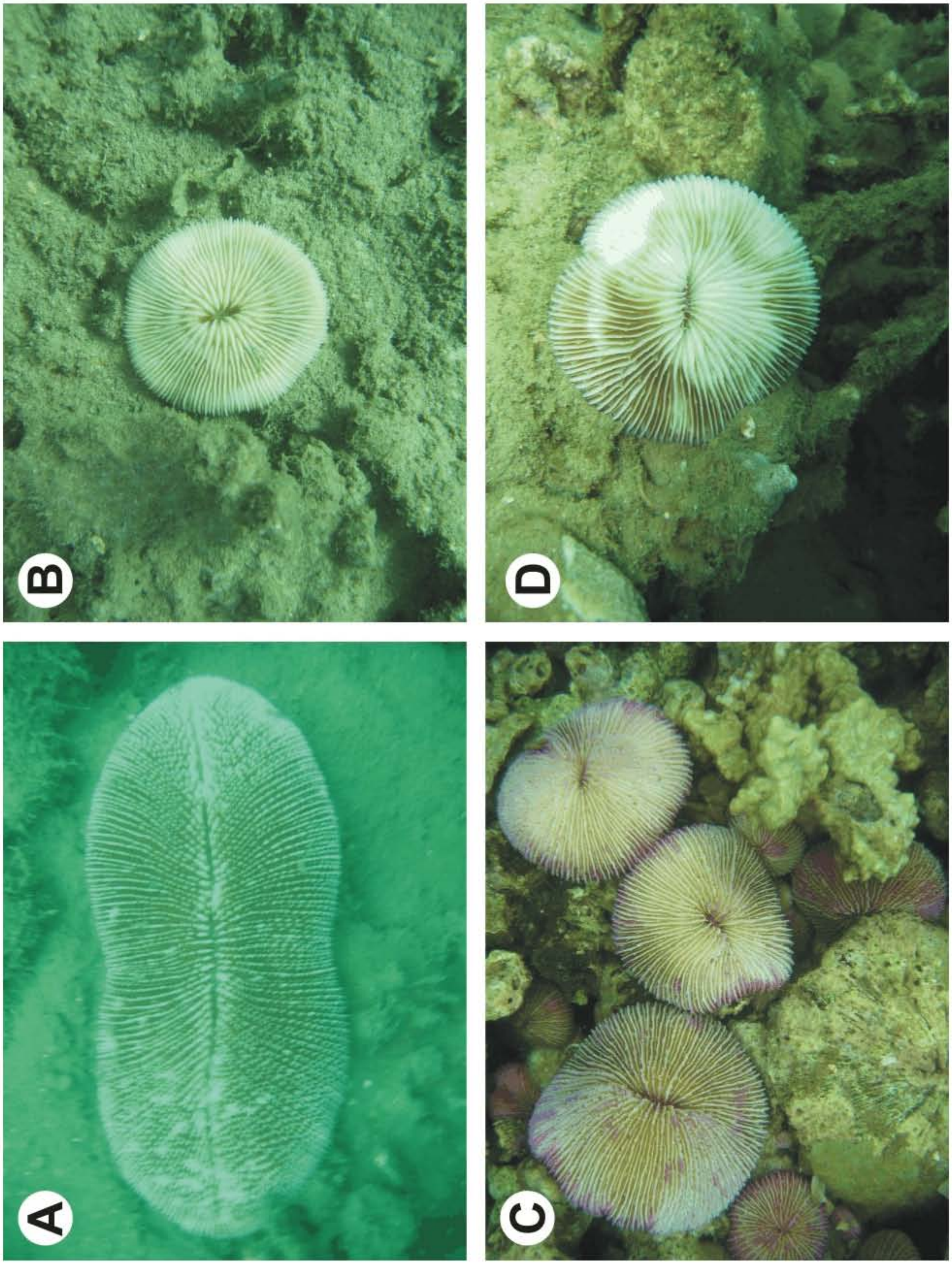

A
B
C
D

Plate XII

A. *Fungia scutaria*. Near Transect 4, reef slope, 5 m.

B. *Herpolitha limax*. Near Transect 7, reef slope, 9 m.

C. *Polyphyllia novaehiberniae*. Transect 11, reef margin, 1 m.

D. *Polyphyllia talpina*. Transect 4, upper reef slope, 3 m.

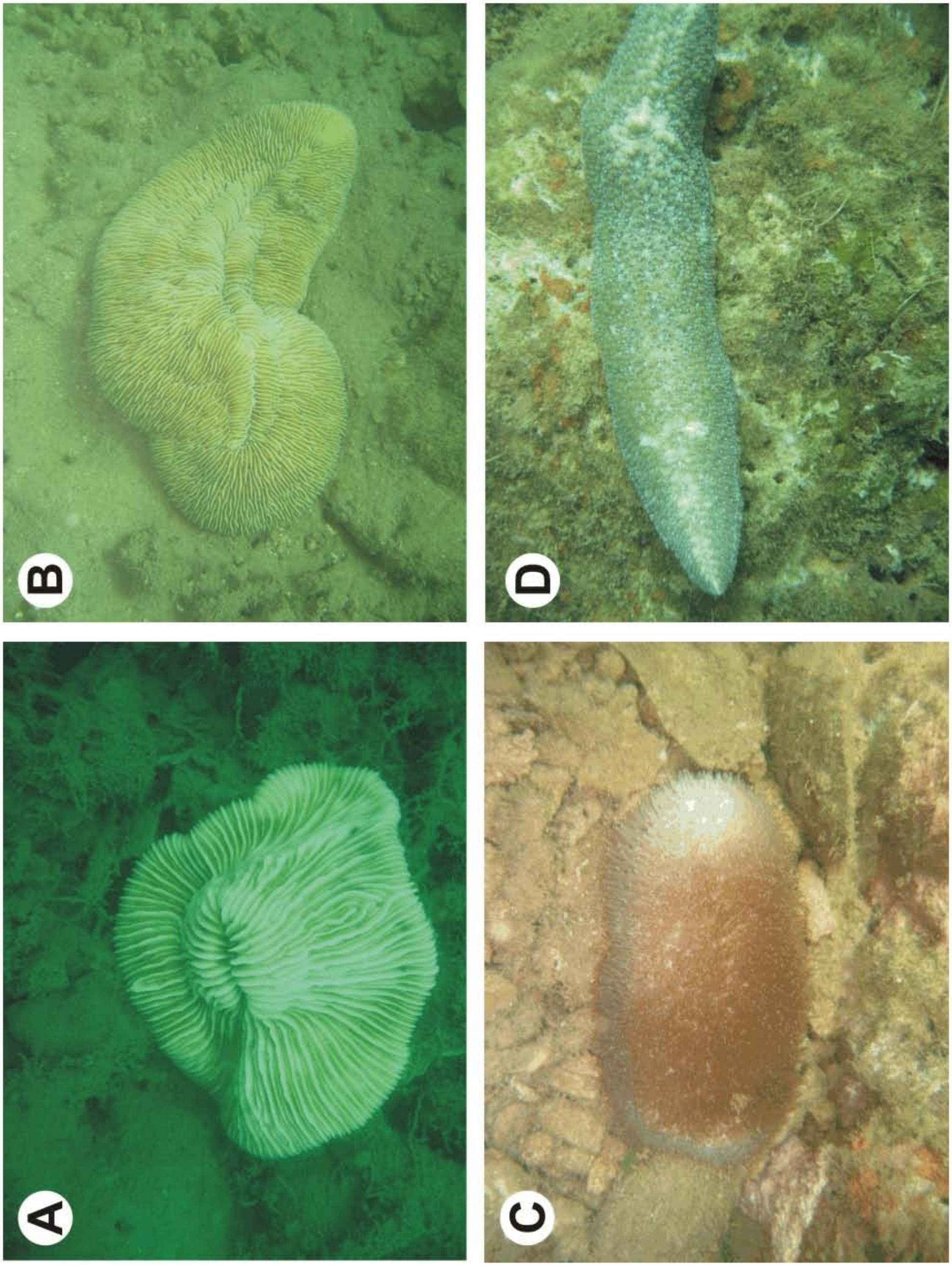

A
B
C
D

PLATE XIII

A. *Zoopilus echinatus*. Near Transect 6, coral knoll, 8 m.

B. *Paraclavarina triangularis*. Near Transect 6, coral knoll, 8 m.

C. *Lobophyllia hemprichii* Near Transect 6, coral knoll, 8 m.

D. *Galaxea fascicularis*. Near Transect 7, reef slope, 7 m.

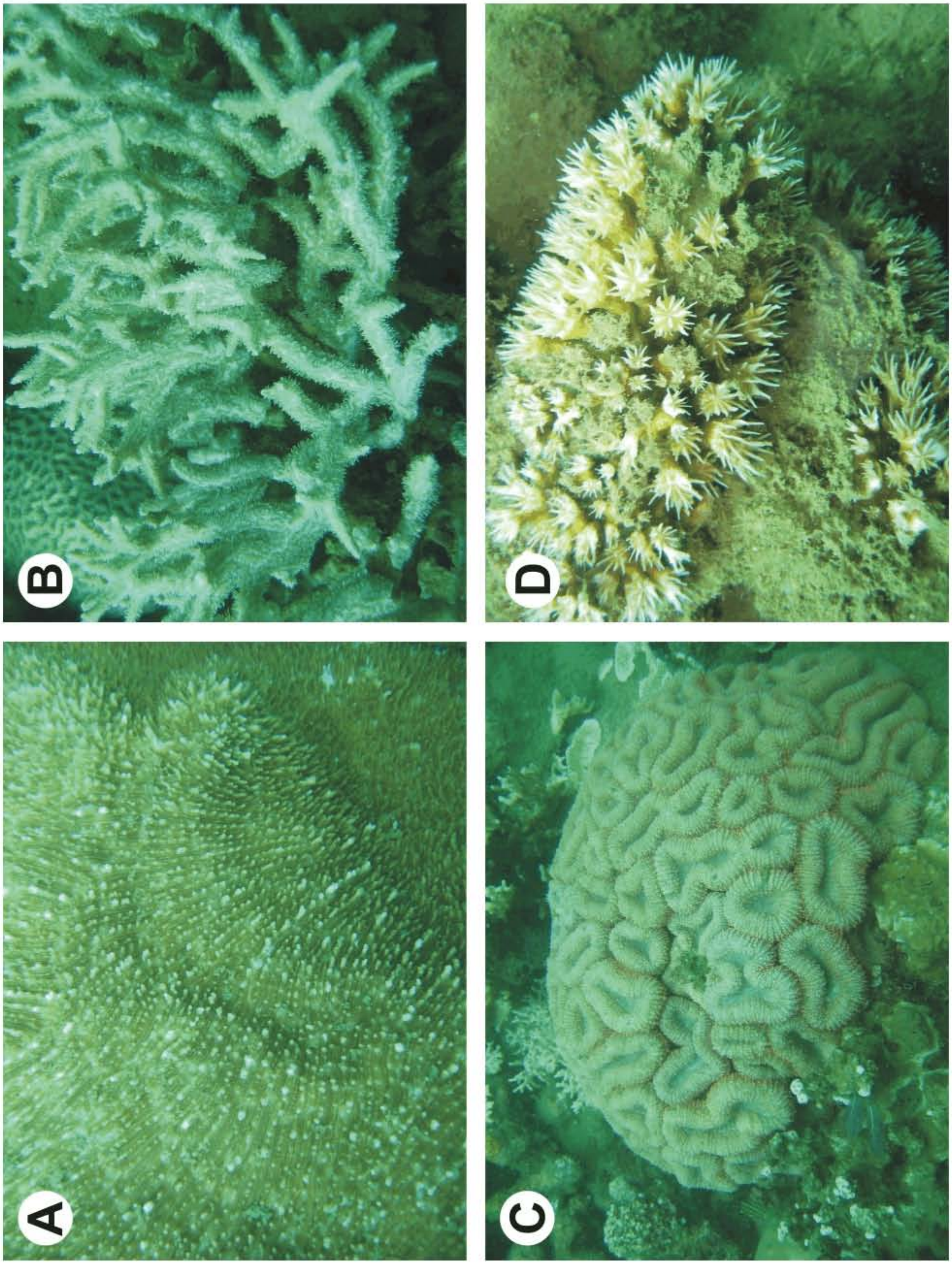

A
B
C
D

Plate XIV

A. *Galaxea horrescens*. Transect 13, reef margin, 1 m.

B. *Echinophyllia aspera*. Near Transect 6, coral knoll, 8 m.

C. *Mycedium elephantotus*. Near Transect 6, coral knoll, 8 m.

D. *Pectinia alcicornis*. Near Transect 6, coral knoll, 8 m.

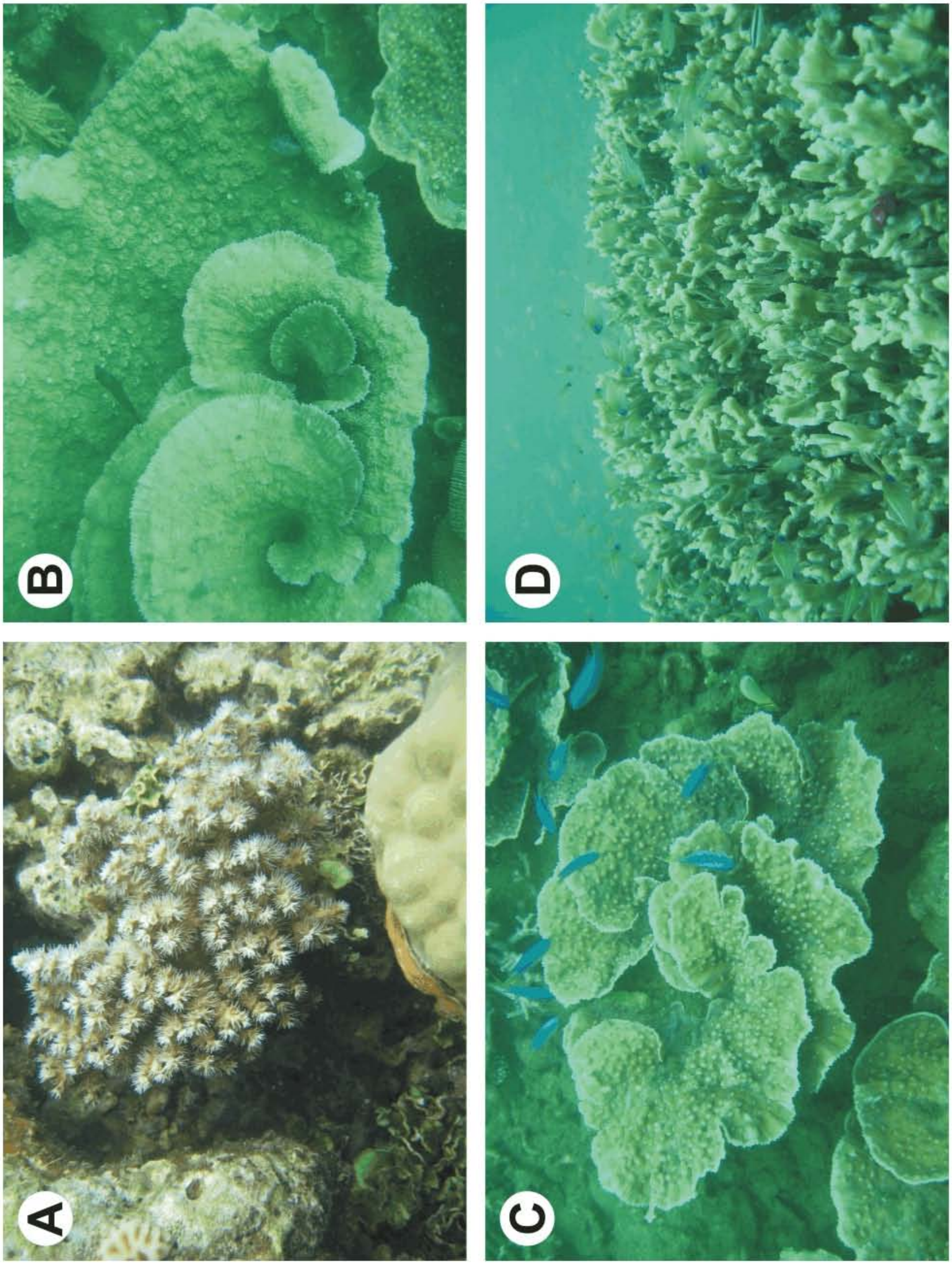

A
B
C
D

Plate XV

A. *Pocillopora damicornis*. Transect 2, transition zone, 2 m.

B. *Goniopora columna*. Near Transect 6, coral knoll, 8 m.

C. *Porites rus*, columnar form. Transect 4, upper reef slope, 3 m.

D. *Porites* sp. cf. *australiensis*. Near Transect 2, transition zone, 1 m.

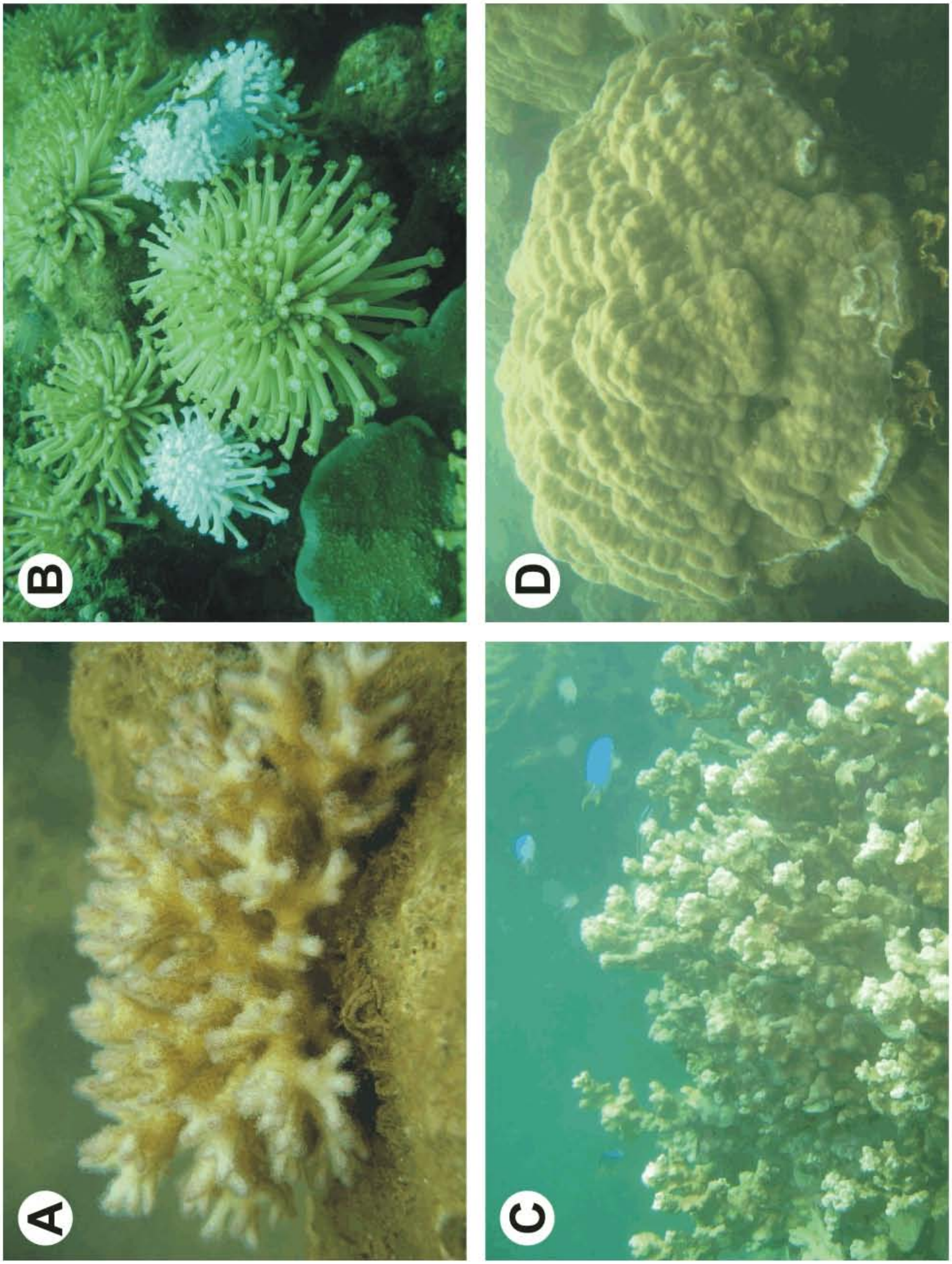

B
D
A
C

PLATE XVI

A. *Porites rus*, subcolumnar form in shallow water. Near Transect 3, reef margin, 1 m.

B. *Porites rus*, shelving plate-like form in deeper water. Near Transect 4, reef slope, 4 m.

C. *Psammocora contigua*. Near Transect 7, reef slope, 9 m.

D. *Psammocora digitata*. Transect 3, reef margin, 1 m.

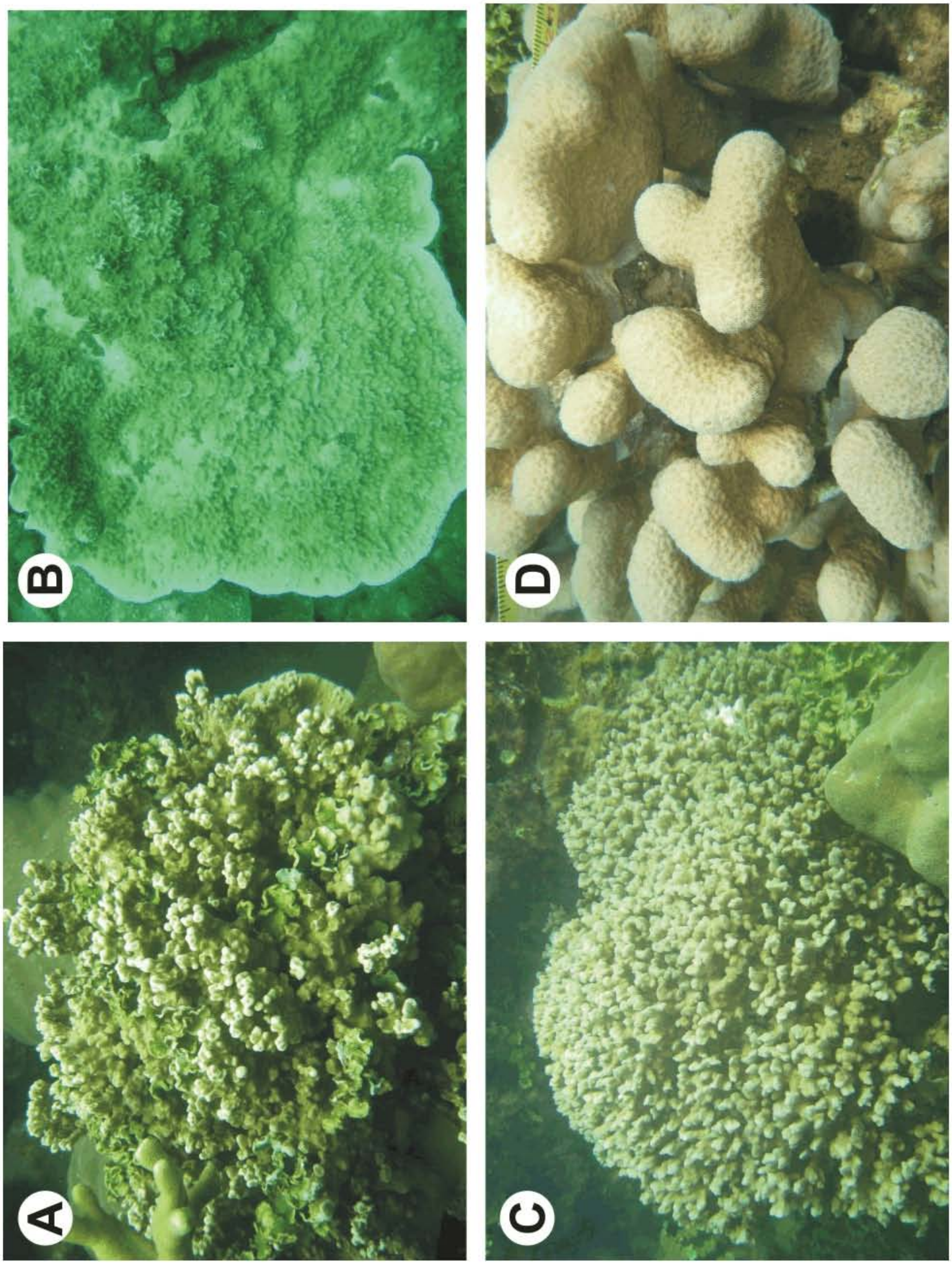

A
B
C
D

PLATE XVII

A. *Psammocora obtusangula*. Transect 4, reef slope, 4 m.

B. *Psammocora* sp. Transect 10, reef slope, 5 m.

C. *Heliopora coerulea*. Transect 6, coral knoll, 8 m.

D. *Millepora dichotoma*. Near Transect 7, reef slope, 9 m.

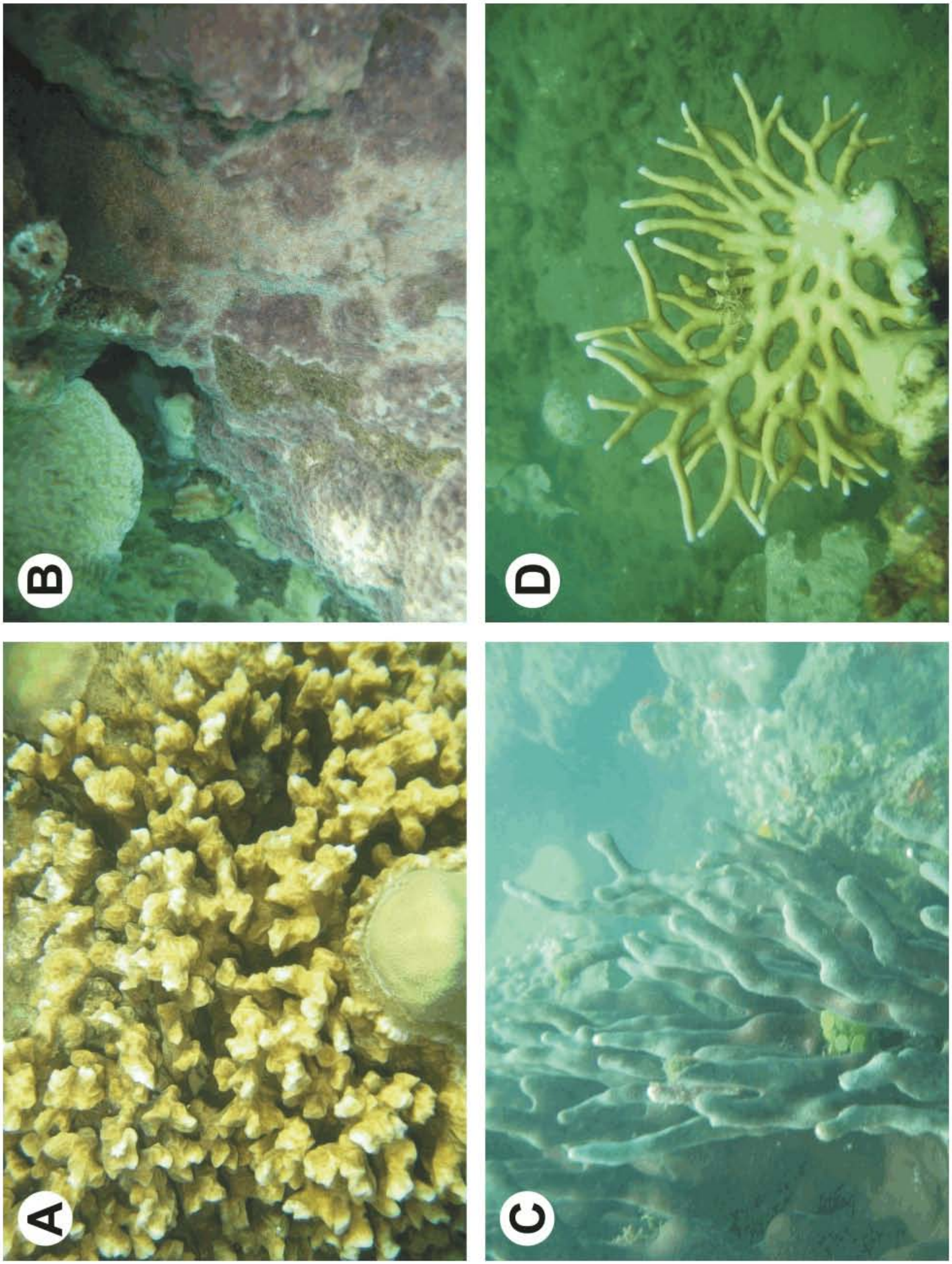

B
D
A
C

PLATE XVIII

REEF D

A. Reef slope community dominated by *Porites* spp. and *Montipora digitata*.

B. Upper reef slope community dominated by massive *Porites* spp.

C. Reef slope with *Porites* spp. and *Acropora* spp.

D. Upper reef slope community dominated by *Millepora dichotoma* and *Acropora* spp.

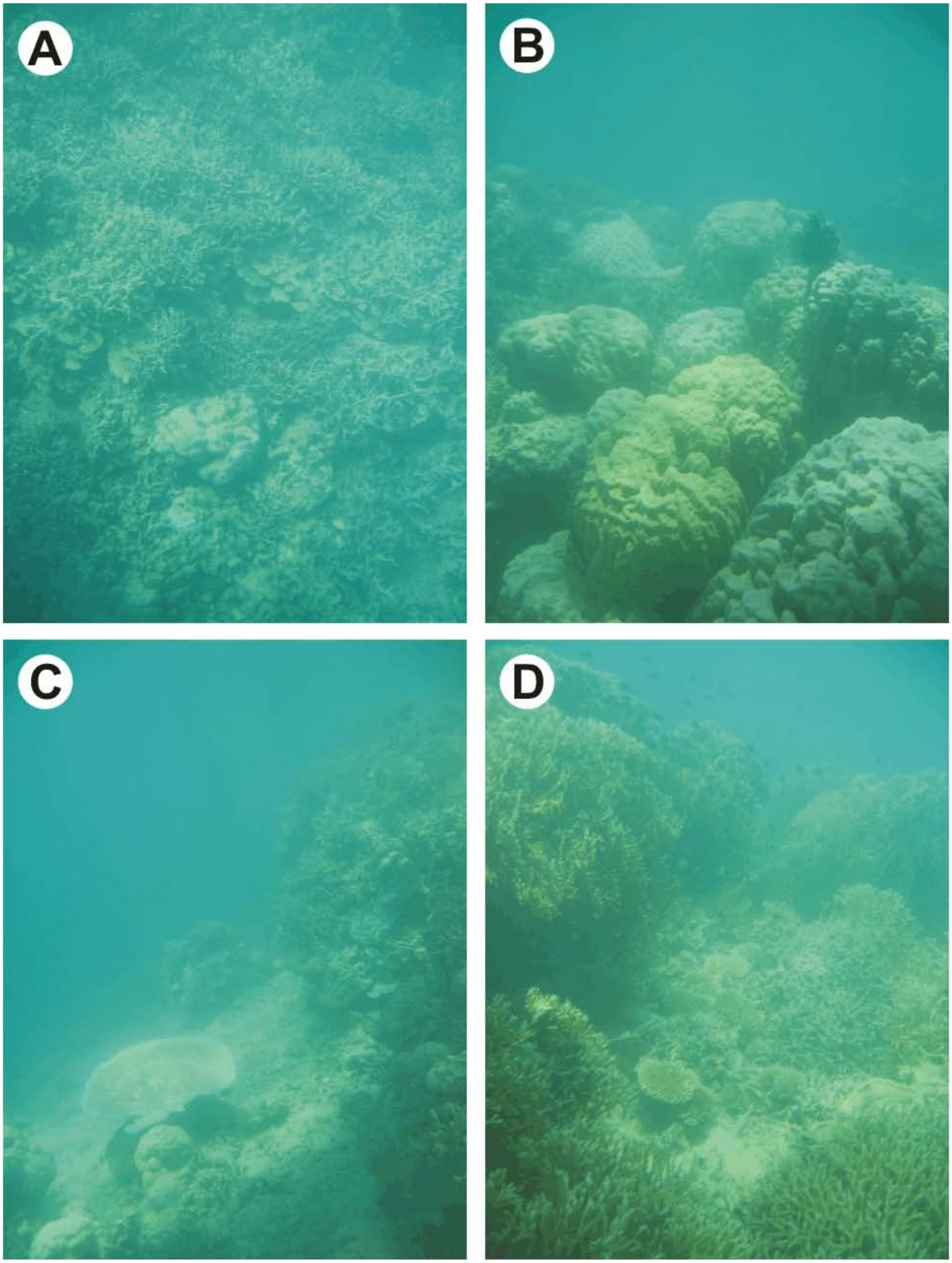

A
B
C
D

PLATE XIX

REEF D

A. Reef slope community dominated by *Montipora digitata*.

B. Lower reef slope, with *Montipora digitata* and *Pachyseris speciosa*.

C. Mixed reef slope community dominated by *Porites* spp., *Montipora digitata*, and *Acropora* spp.

D. Reef slope community dominated by *Pachyseris speciosa*.

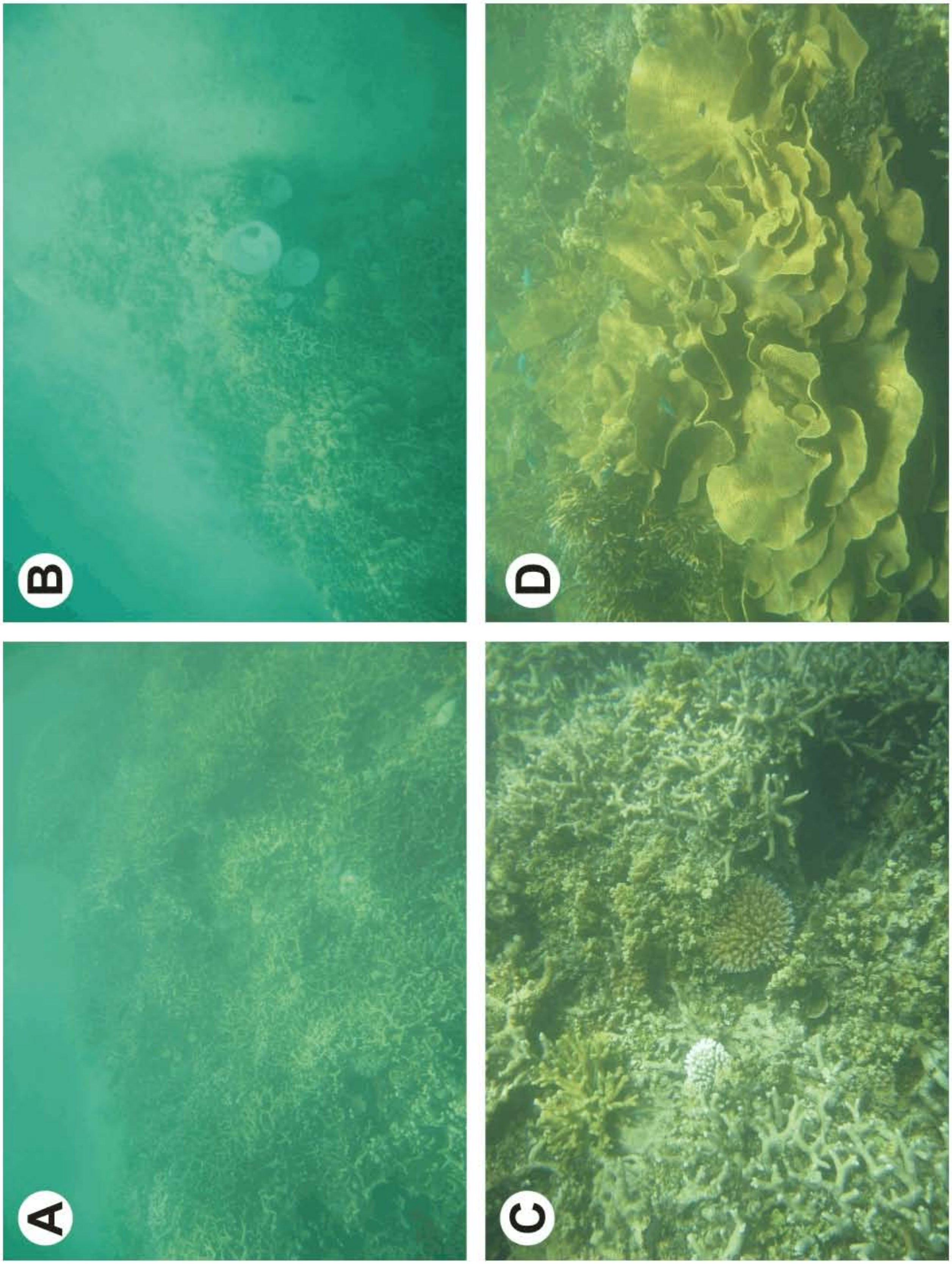

A
B
C
D

PLATE XX

REEF D

A. Lower reef slope dominated by sediments and coral rubble.

B. Reef slope with *Montipora digitata*.

C. Lower reef slope with *Montipora digitata* and *Pachyseris speciosa*.

D. Upper reef slope with massive *Porites* spp. and *Ctenactis* spp.

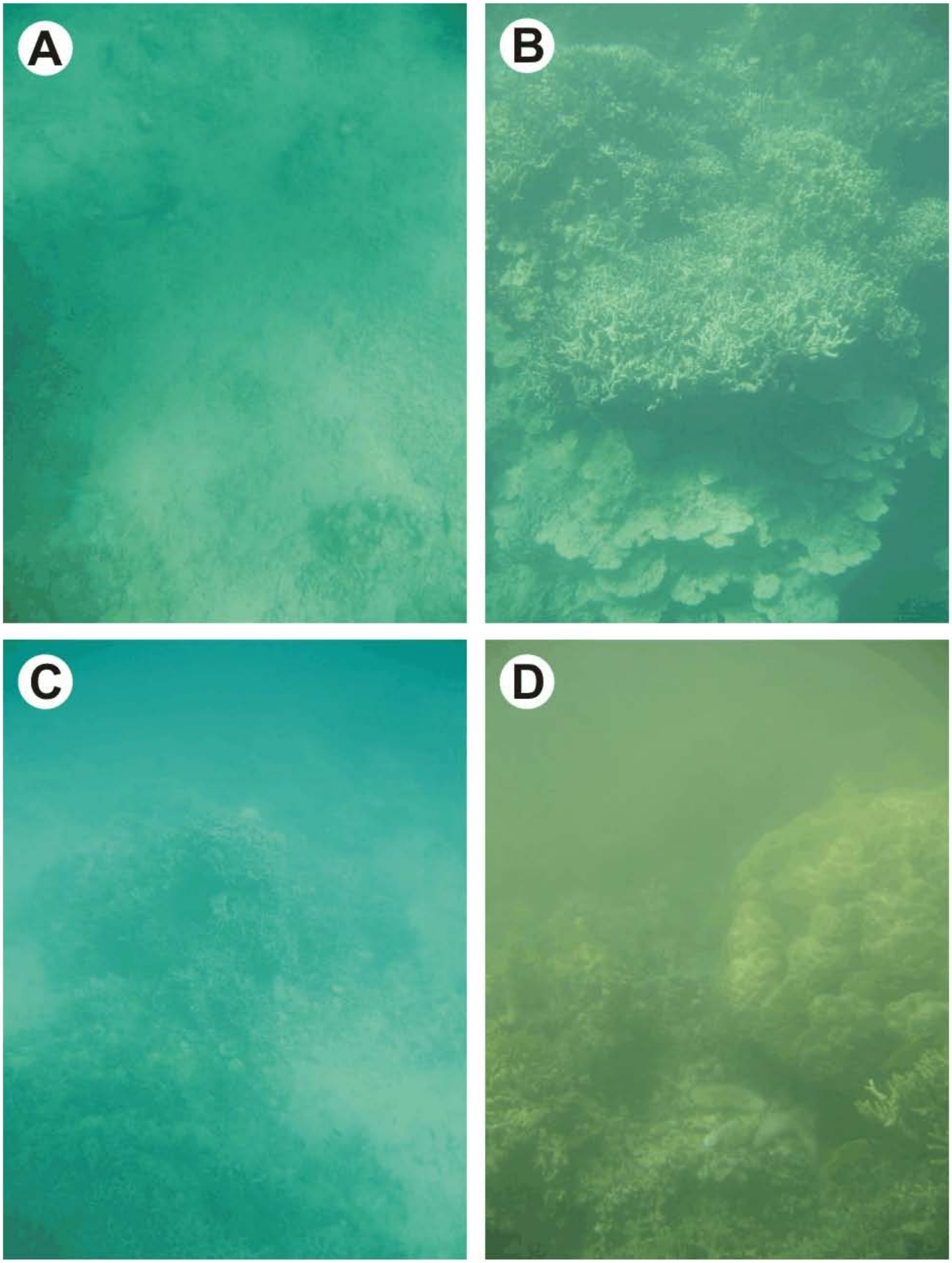

A
B
C
D

Plate XXI

<u>Reef E</u>

A. Upper reef slope dominated by *Porites* spp.

B. Reef slope community dominated by *Porites* spp. and *Diploastrea heliopora*.

C. Reef slope community dominated by *Porites* spp.

D. Reef slope community dominated by *Porites* spp. and *Montipora digitata*.

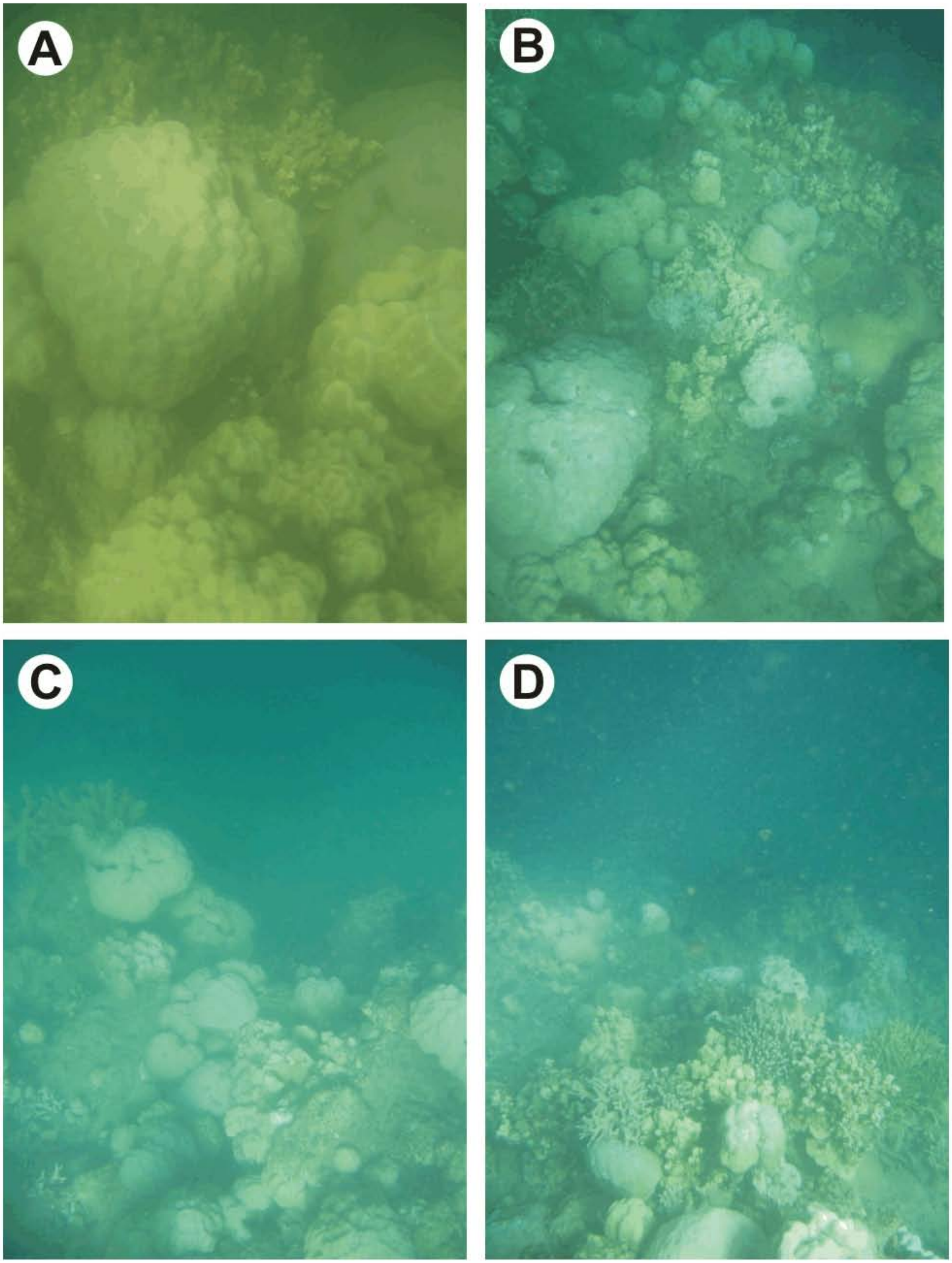

A
B
C
D

Plate XXII

<u>Reef E</u>

A. Reef slope community dominated by *Millepora dichotoma* and *Porites rus*.

B. Reef slope community dominated by *Porites* spp.

C. Upper reef slope community dominated by massive *Porites* spp.

D. Upper reef slope community dominated by *Porites* spp. and *Montipora digitata*. A school of *Sepioteuthis* cf. *lessoniana* is pictured near the surface.

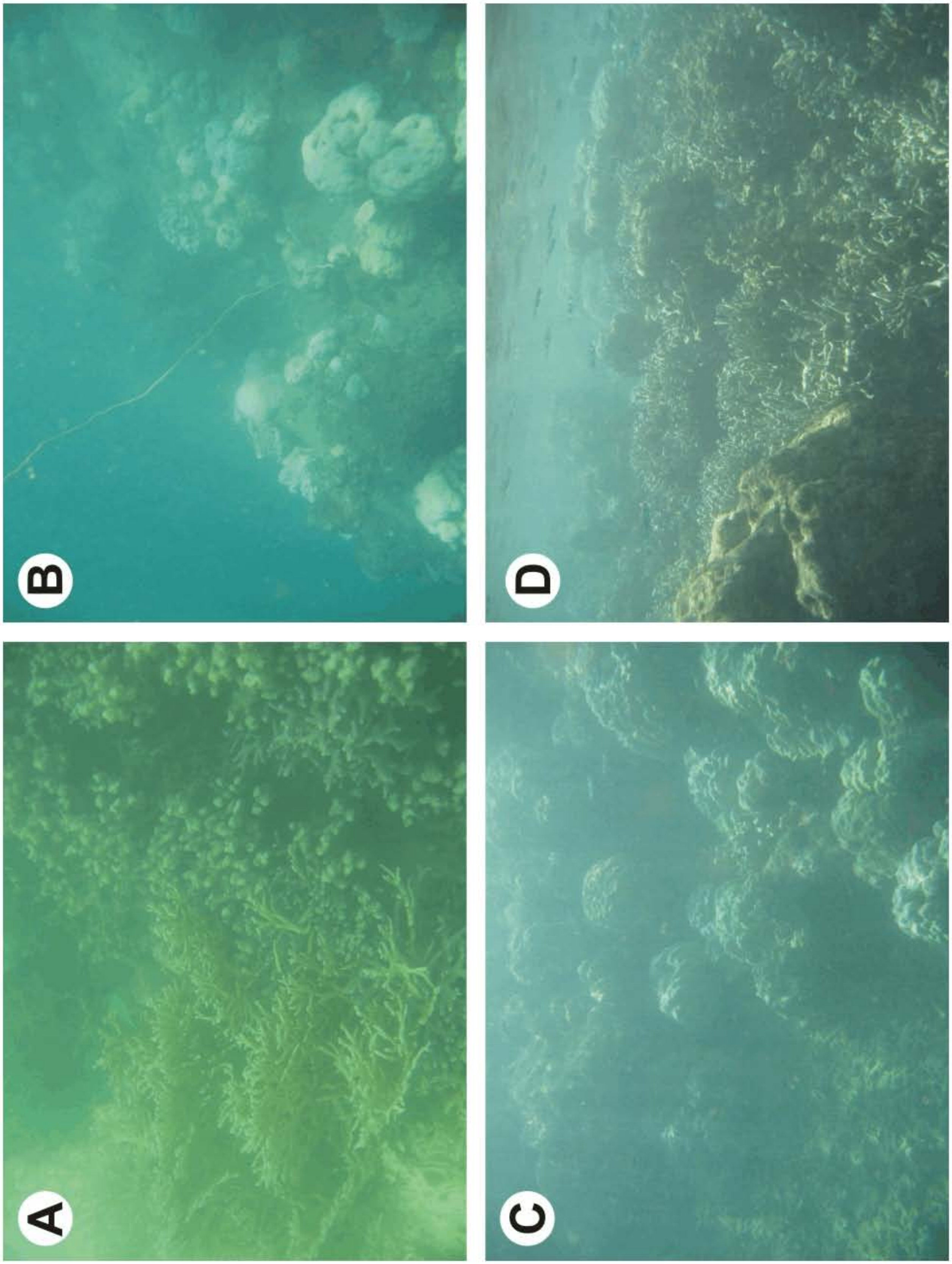

A
B
C
D

Plate XXIII

Nett Reef

A. Reef flat community dominated by *Montipora digitata*.

B. Reef flat community dominated by *Porites rus*, *Montipora digitata*, and *Millepora* spp.

C. Lower reef slope with *Montipora digitata*, *Porites* spp., and *Seriatopora hystrix*.

D. Reef margin dominated by massive *Porites* spp.

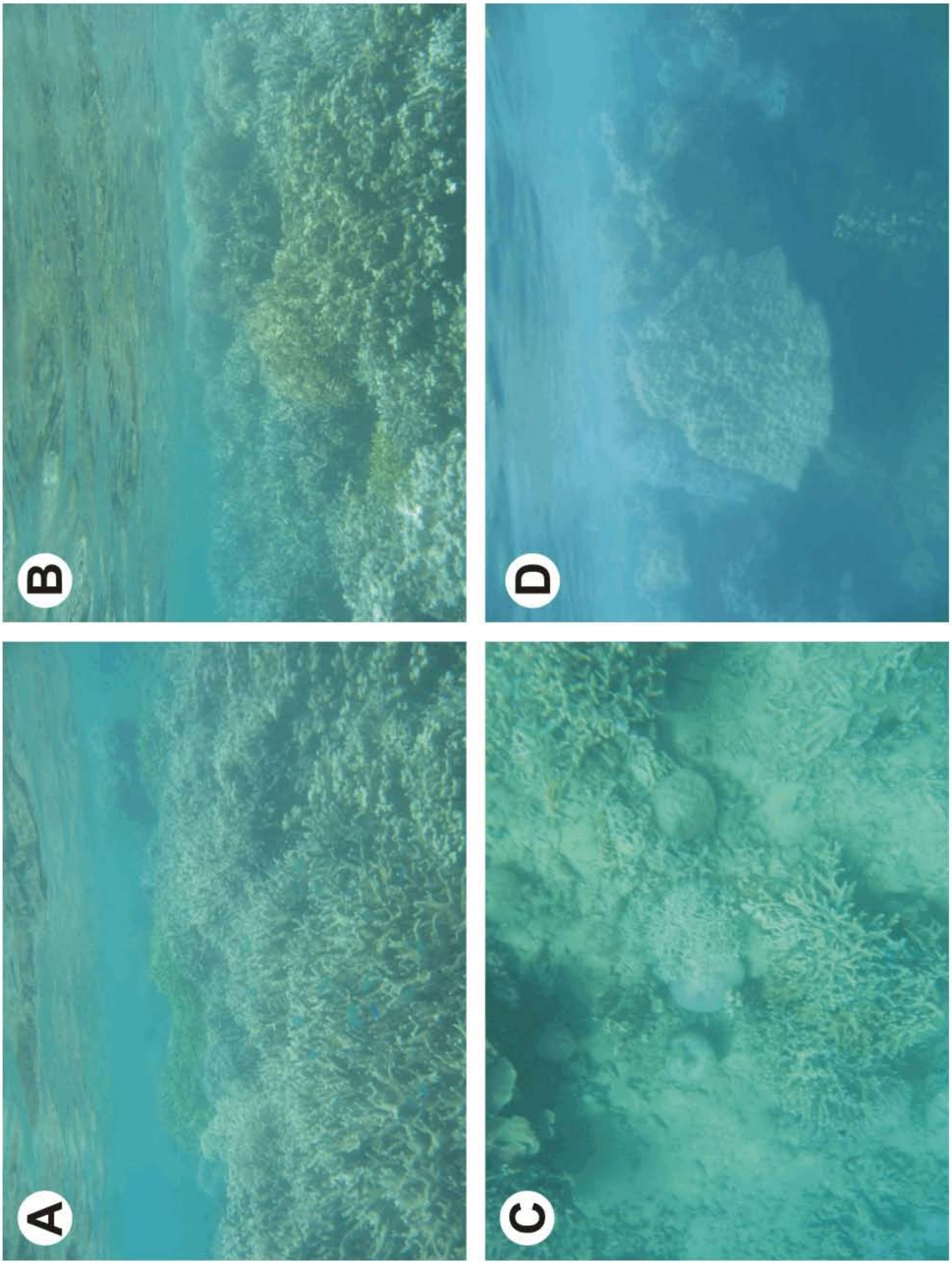

A
B
C
D

Plate XXIV

Nett Reef

A. *Montipora digitata* colonies on the upper reef slope.

B. Lower reef slope dominated by coral rubble and sediment.

C. Reef slope community dominated by alcyonacean *Sinularia* spp. and *Porites* spp.

D. Reef slope community dominated by massive *Porites* spp. and *Montipora digitata*.

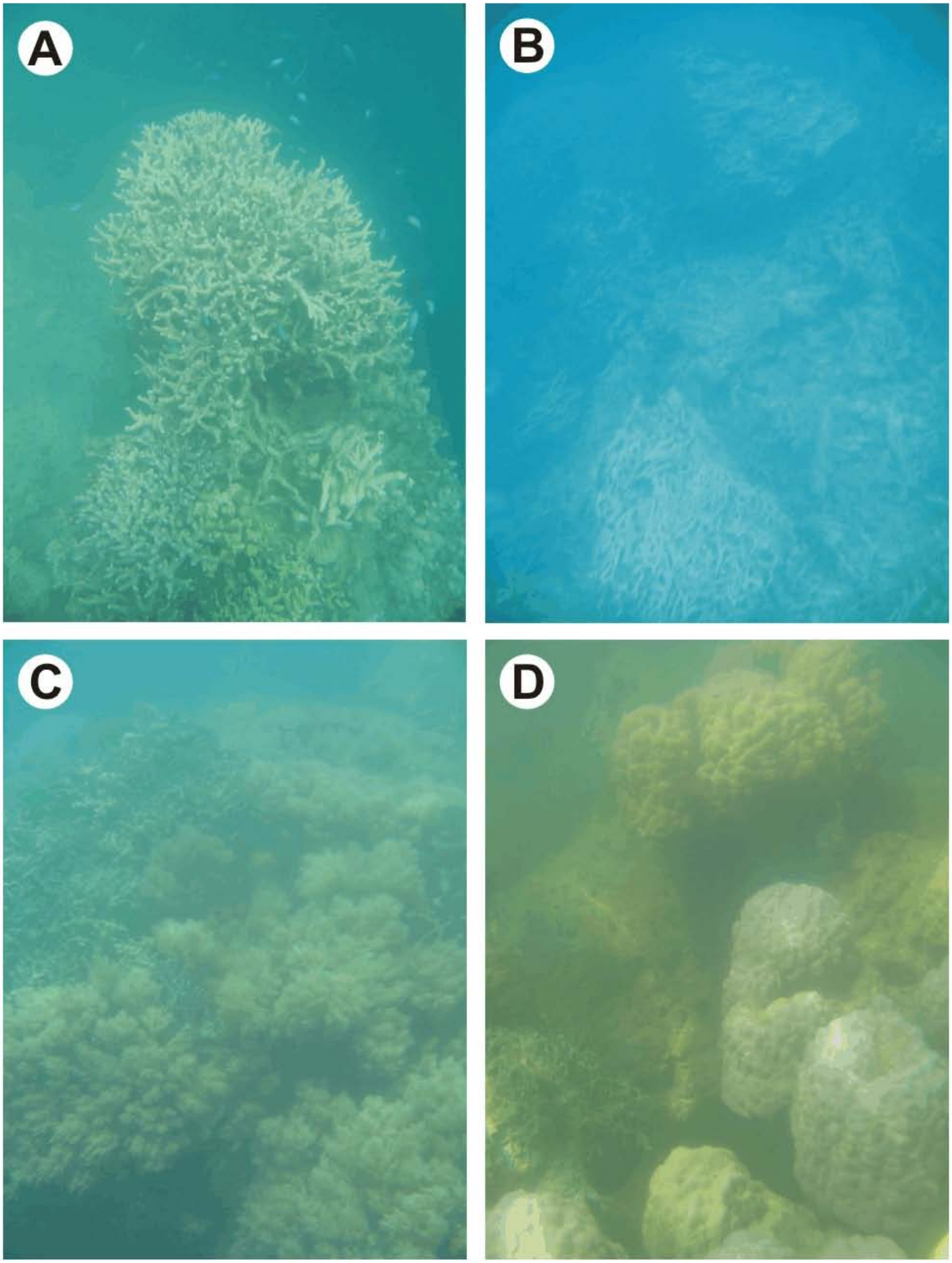

A
B
C
D

PLATE XXV

NETT REEF

A. Reef margin community dominated by *Montipora digitata* and massive *Porites* spp.

B. Reef slope community dominated by *Pachyseris speciosa* and *Porites* spp.

C. Reef slope community dominated by *Montipora digitata* and *Porites* spp. The school of fishes are *Pterocaesio* sp.

D. Reef slope community dominated by massive *Porites* spp.

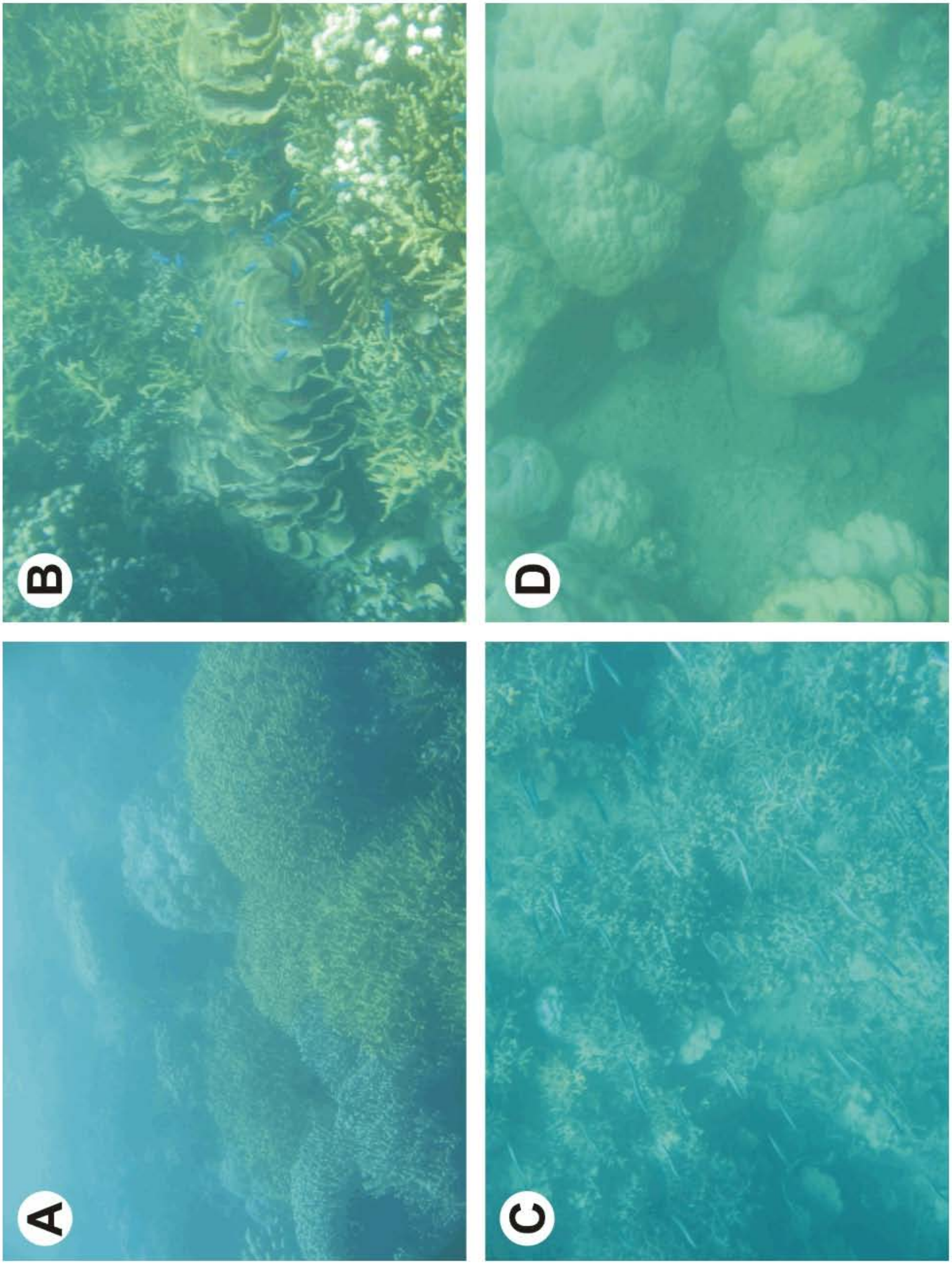

A
B
C
D

PLATE XXVI

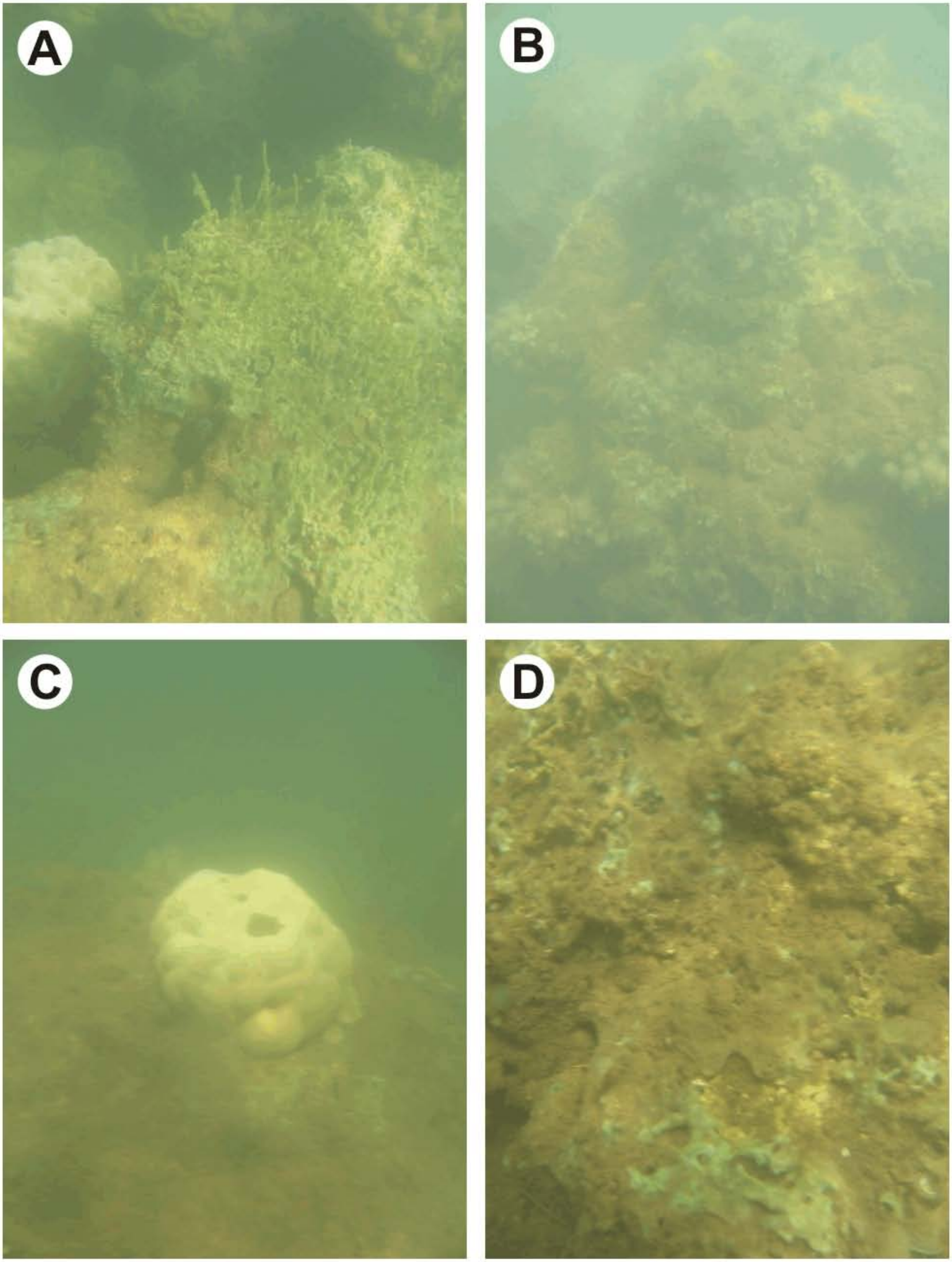
DAUSOKELE CHANNEL MARGIN

A. Channel margin with *Porites* spp. and the encrusting sponge *Dysidea* sp. cf. *herbacea*.

B. Sediment-laden channel margin supporting *Dysidea* spp. and the ascidian *Eudistoma toealensis*.

C. Colony of massive *Porites* spp. on the channel margin.

D. Detail of sediment-laden reef rock on the channel margin, with encrusting *Dysidea* spp.


A
B
C
D