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Natural History of Madang Lagoon with an Appendix of Collecting Localities*

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ABSTRACT. Systematic collections have revealed that the Madang Lagoon is a highly heterogeneous reef system which shows an unprecedented diversity of marine invertebrates (e.g., about 180 species of gammaridean Amphipoda). The characteristics of the Madang Lagoon, including its geological origin, physical geography, and physical and biological oceanography, are described and discussed. Traditional names are used for the reefs and islands of the lagoon. An appendix includes a list of all current collecting localities for the Madang Lagoon amphipod project. Coordinates for these collecting localities have been determined using a global positioning device.

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During parts of February and March from 1989 to 1991 J.L. Barnard, Smithsonian Institution, Washington, DC, USA (since deceased), J.K. Lowry, Australian Museum, Sydney, Australia, A.A. Myers, Cork College, Cork, Ireland and J.D. Thomas, Smithsonian Institution, Washington, DC (then of the Reef Foundation, Big Pine Key, Florida, USA), collected amphipods from the Madang Lagoon and adjacent waters (Fig. 1). The objective of this work was to collect all the gammaridean amphipod species from the lagoon and adjacent areas with the intention of describing the fauna. Because of

the unique tectonic and geological history of northern New Guinea in general and the Madang Lagoon in particular, the results of this work should, in addition to documenting the amphipod fauna, provide new insights into the diversity and distribution patterns of Indo-west Pacific amphipods.

Three hundred and six separate samples were made by diving and trapping. Coral rubble was collected in large buckets or bags. Sediments were collected in plastic bags, fine mesh bags by swimming along the bottom like a human dredge or with an airlift. Algae,

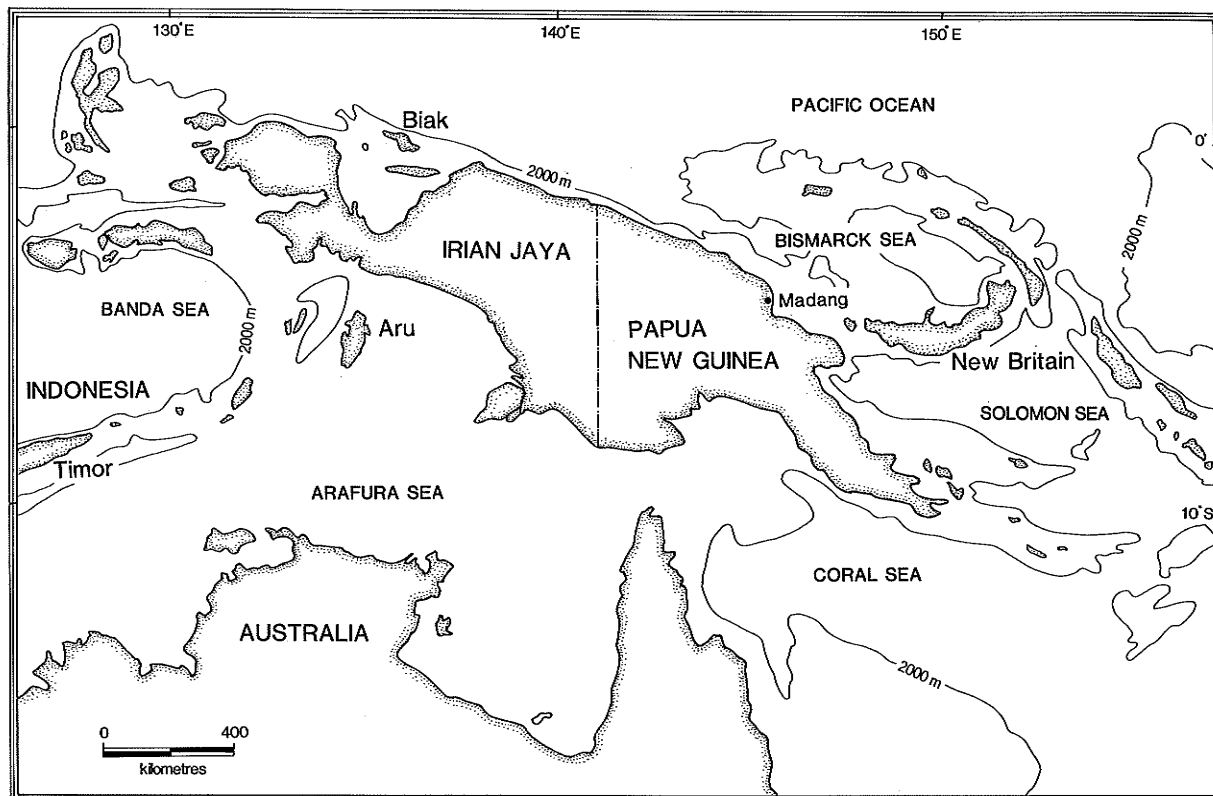


Fig. 1. Papua New Guinea and the Madang area.

seagrasses, sponges and tunicates were collected separately in plastic or fine-mesh bags. Baited traps were set in all of the lagoon habitats, down the face of the outer barrier and onto the sea bottom of Astrolabe Bay to a depth of 500 m. Occasionally we night-lighted from a small boat over reef or soft bottoms or towed a plankton net.

The sorted and identified collections indicate an amphipod fauna in excess of 180 species. These species have been identified and divided between us, mainly at the family level, for study and description in a series of papers.

Publication of Results

It is expected that the majority of taxonomic accounts from the study will be published in the *Records of the Australian Museum*. A series of paratypes, for as many species as possible, will be held in trust by the Australian Museum on behalf of Papua New Guinea, until such time as they are required.

Several papers describing new species from this study have already been published. Lowry & Stoddart (1990) described two new species of wandinid lysianassoids, *Pseudocyphocaris gosema* and *P. lobata*. Thomas &

Barnard (1991a) described a new species of corophiid corophioid, *Kamaka taditadi*, and (Thomas & Barnard, 1991b) a new species of iphimiid, *Iphimedia xesta*. Lowry & Stoddart (1992) described a new species of uristid lysianassoid *Ichnopus malpatun* from the face of the outer barrier of Madang Lagoon.

The Physical Environment and its History

Christensen Research Institute (CRI) lies on the inner coastline of a large lagoon about 16 km long and 4 km wide (a total area of 40 km²) (Fig. 2). This is bordered on its seaward edge by a narrow barrier reef, which is steep-sided on its seaward side, with depths of 400 m found within 1 km of the reef. Inside the lagoon the bottom is even in depth (30–40 m), and there are numerous shallow patch reefs and coral rubble islands that support rich fringing reefs. The inner coastline is much dissected by deep "harbours" which appear to have formed through differential coral growth around river systems. This inner coast has shallow fringing reefs between 10 and 50 m wide. The reef slope of these and the patch reefs fall off steeply at angles of 20° to 30° to the lagoon floor. The lagoon bottom is generally covered by a thick layer of silty clay that supports a

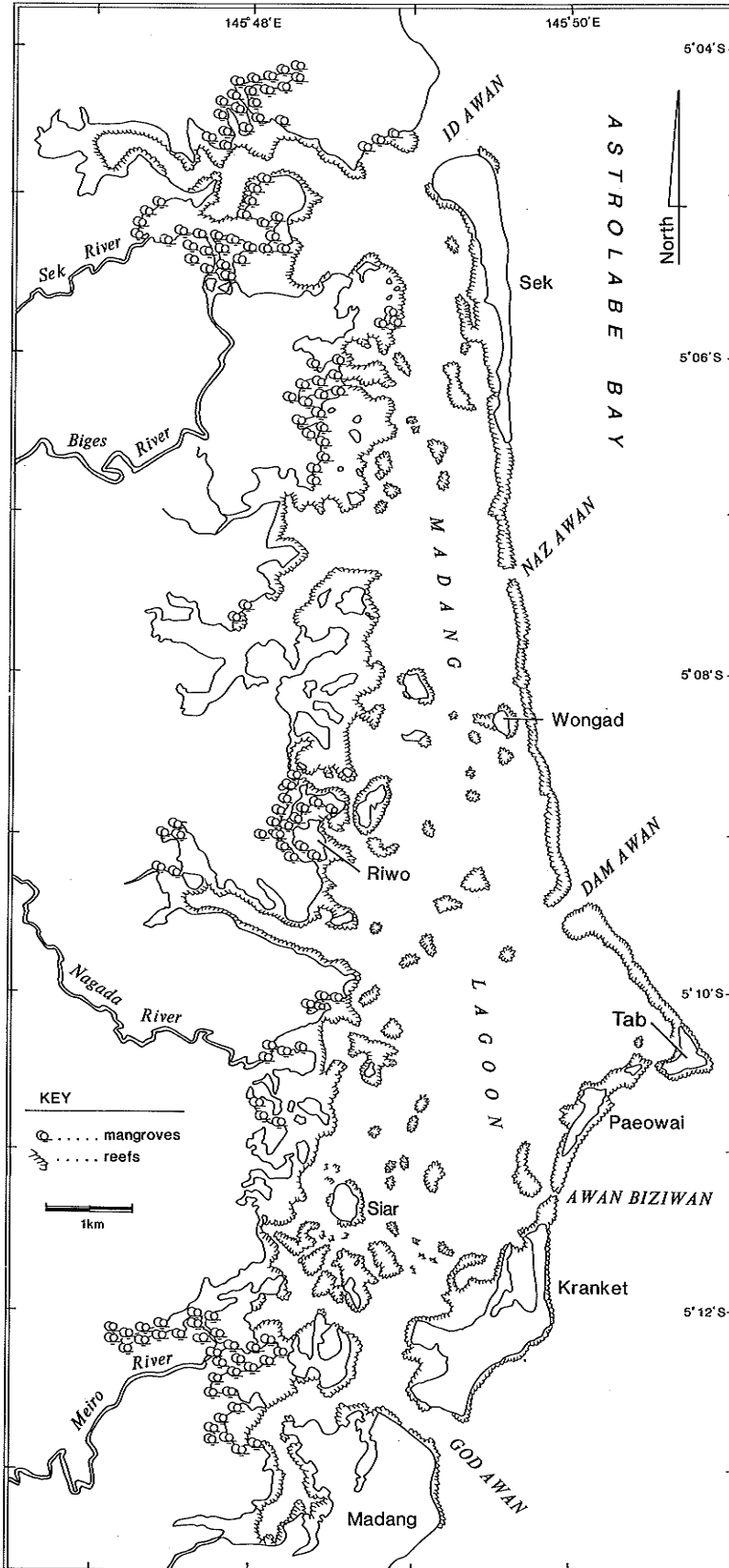


Fig. 2. Madang Lagoon indicating major landmarks.

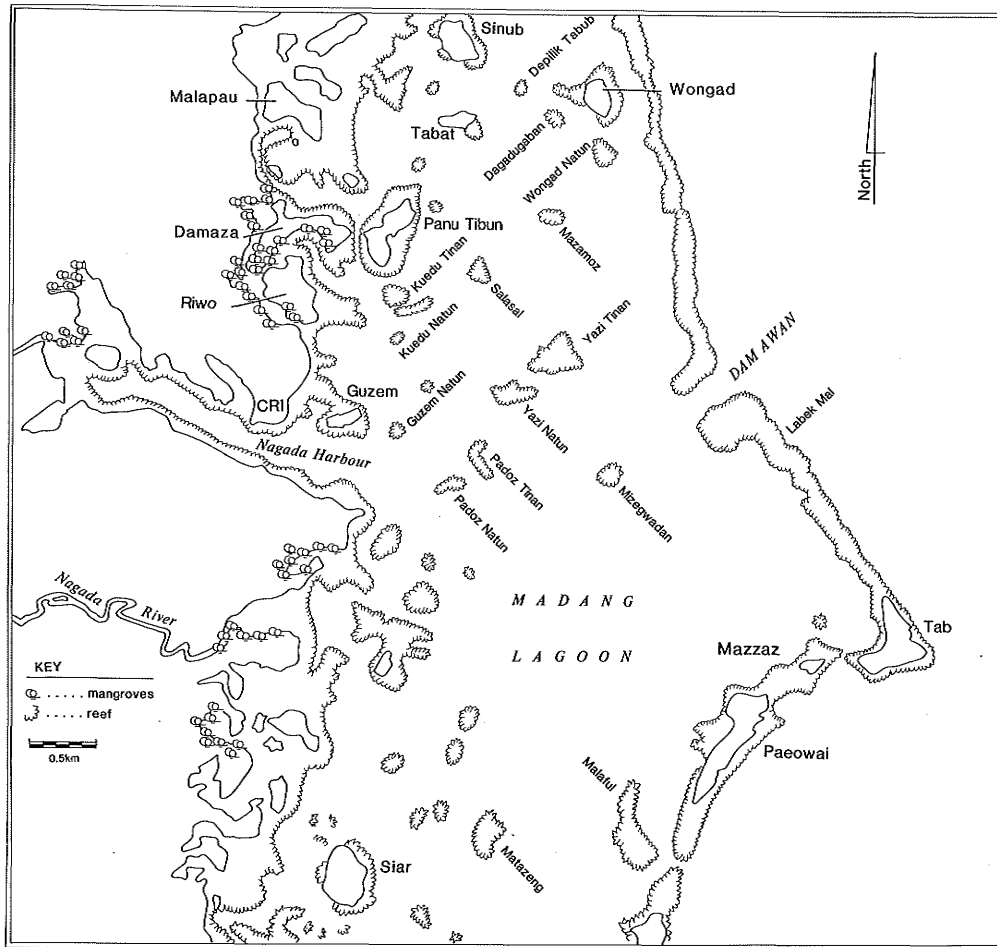


Fig. 3. Madang Lagoon indicating traditional reef and island names.

rich burrowing fauna. Coarse sand and coral rubble dominate near the deep water passages and reefs.

There are two major river inlets within the lagoon, Biges River at the extreme north and Meiro and Wagol Rivers at the extreme south. These rivers carry silty water which traverses the whole lagoon after heavy rains and generally leaves the lagoon rapidly without mixing appreciably. Several other minor inputs also occur, but in relative terms, the catchment behind the lagoon system is small. The watershed lies about 6 km inland, and with the exception of the above river systems, it scarcely exceeds the area of the lagoon.

There are five major passages through the barrier reef; Id Awan, Naz Awan, Dam Awan, Awan Biziwan and God Awan. These passages are as deep or deeper than the floor of the lagoon.

Similar lagoonal systems are found to the north; Sarang, Dilup and Rempi, and east of Madang at Gitua, Sialum, Finsch and Dreger Harbours. The Madang Lagoon however, exceeds all of these in complexity and size.

Two geological events are of equal importance to a discussion of the Madang Lagoon and its biota. Firstly

the broad scale tectonic history provides an understanding of the major biogeographical units that have come together to make up the north coast of New Guinea over the past 50 million years. On a local scale the Quaternary (last 2 MA) history of tectonic uplift and accompanying fluctuations in eustatic sea level, especially during the Holocene (last 10 KA), have brought about the present coral reef structure we see today in the Madang region.

Tectonic History

The island of New Guinea is composed of at least 32 separate terranes (micro-continental plates) located on four lithospheric plates (Indo-Australian, North Bismark Sea, South Bismark Sea and Pacific) (Pigram & Davies, 1987). Pandolfi (1992) has recently summarised the tectonic history of New Guinea and its biogeographic significance.

About 50 MA ago the Indo-Australian plate rifted from the Antarctic plate and began a northward migration

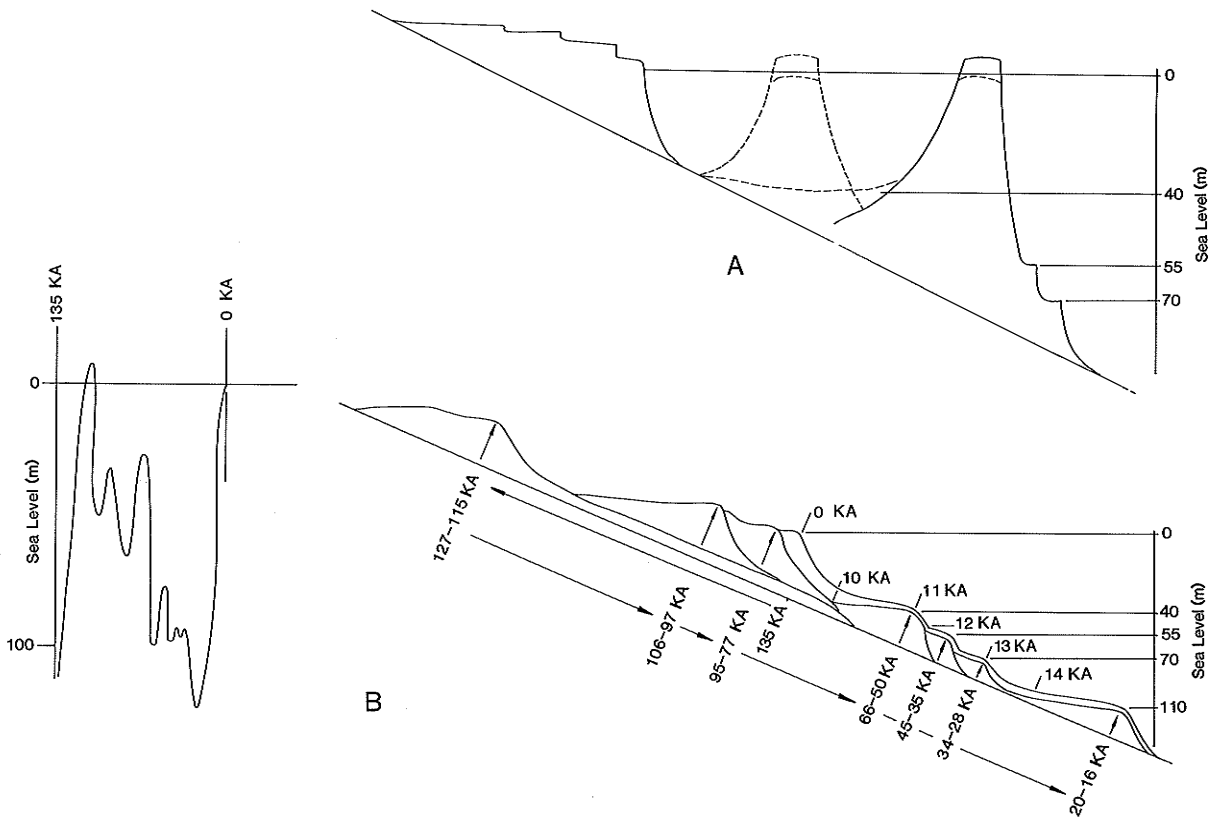


Fig. 4. A, idealised cross section of Madang Lagoon; B, Madang Lagoon formation.

that led to the collision of the Gondwanan and Laurasian fragments to create both the island of New Guinea and the Indonesian Archipelago.

As it drifted northwards, the edge of this plate began a long period of collision with a complex subduction zone, starting about 30 MA (middle Oligocene). During this period terranes began to dock with the northern coastline of New Guinea. Of the 32 techno-stratigraphic terranes identified by Pigram & Davies (1985, 1987) some were displaced portions of the northern edge of the Indo-Australian plate, while others were formerly parts of Gondwana that had been detached since the early Mesozoic (180 MA). Some of these terranes are composed of deep-water carbonates, while others indicate that they were plateaus, seamounts or parts of island arcs. The latest of these dockings probably occurred just 2 MA (early Pleistocene) with the collision between the Finisterre Terrane and the New Guinea Orogen (Composite plate) (Crook, 1989).

Accompanying this northward drift was a counter-clockwise rotation which led to a period of collision from 15 MA (Mid-Miocene) to 5 MA (Pliocene) between the Indo-Australian plate and the Asian component of Laurasia, creating much of the eastern Indonesian archipelago (Audley-Charles, 1981). This created a

massive barrier across what was formerly a major connection between the Pacific and Indian Oceans.

These docking events brought together vast areas of reef systems, along with their associated faunas, formerly separated over many hundreds or thousands of kilometers of ocean. Formerly dispersed biogeographic elements have thus been brought together continuously over the past 30 MA. The biogeographic consequences of such a composite unit has led to the loss of any discernible pattern of distribution, as well as unexpectedly high diversities.

Sea Level Changes—Formation of the Lagoon

During the Pleistocene (2 MA to present) there have been regular cycles of Ice ages, leading to the lowering of sea levels throughout the world (eustatic).

The ongoing tectonic uplift of some parts of the north coast of New Guinea led to the development of massive raised carbonate terraces during periods of sea level rise (Chappell, 1974). During the last 120,000 years, eustatic sea levels have mostly been lower than today, with the last major inundation occurring from about 18,000 years ago, when sea level stood some 130 m below modern

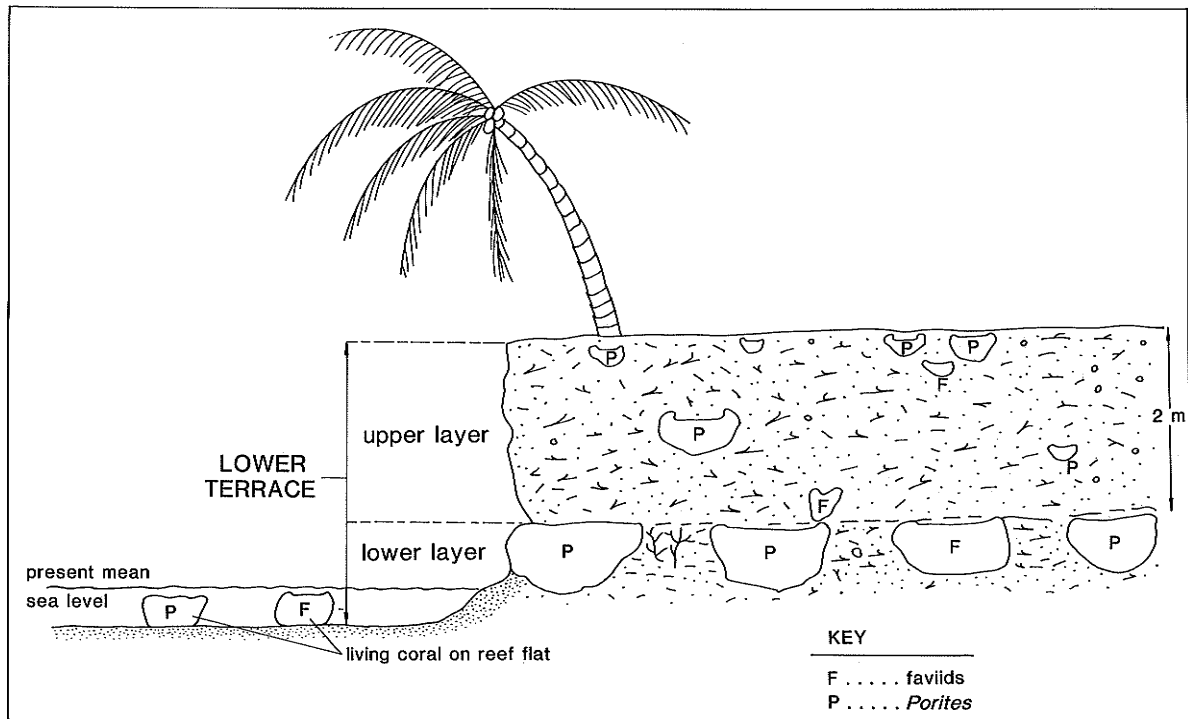


Fig. 5. Cartoon of the raised reef terraces at Jais Aben Resort illustrating the nature of, and relationships between, the Upper Layer and the Lower Layer (from Tudhope, 1992).

levels, to 8,000 years ago, when it was within 20 m of modern levels (Chappell & Polach, 1976).

Using a computerised model developed by Chappell (pers. comm.) it is possible to examine reef formation with variable tectonic uplift and coral growth rates coupled with known sea level changes. The northern coastline of New Guinea drops off steeply, and there is no continental shelf. Both modern and historic reefs would have been confined to the near or very near-shore environment.

Figure 4A shows the major physical features pertaining to an idealised cross section of the lagoon. The lagoon floor lies at a maximum of 40 m, while outside on the outer barrier wall there are two narrow terraces, one at about 55 m and another at about 70 m. Islands on the barrier, within the lagoon, and along the inner coastline have terraces at about 3 m and 5 m above sea level. Further inland reef terraces lie at 10 to 12 m above current sea level.

Varying the parameters above, it is possible to show that with an assumed constant uplift rate of 0.5 m/KA and reef growth rates between 3 to 4 m/KA (Chappell, [1974] estimated a mean growth of 4.7 m/KA for a 10 KA reef at Sialum), that the major structural features can be accounted for in the following scenario. Rising sea levels (Fig. 4B) accompanied by tectonic uplift lead to the development of reef terraces. In the Madang region seven major reef terraces would

have formed over a period of the last 135,000 years. There is no direct evidence or dated material for this supposition however.

Following formation of the last formed terrace (20–16 KA) sea level rise far outstripped the rate of tectonic uplift as the sea level rose some 30–40 m in the space of 10,000 years. This would have led to the sudden inundation of the terrace formed between 66 and 50 KA. It is possible that during this period the outer barrier and mid-lagoon patch reefs of the Madang Lagoon were formed. Darwin (1854) postulated that the forereef of lagoonal systems outstrips lagoon floor growth since the body of water which accumulates behind such a developing reef becomes depleted in nutrients and is enriched with waste products.

More recent data suggest that fore reefs may grow vertically by between 4 and 12 m/KA, while lagoonal systems would only increase by 1.5 m/KA. Chappell & Polach (1976) have shown that Holocene reef terraces at Sialum accrued at a mean rate of 4.7 m/KA, while the maximum rate was about 8 m/KA. Mid-lagoon patch reefs and islands may have developed in a similar manner during this period.

Chappell (1974) noted that in the western parts of the Huon reef terraces, where uplift rates are of the order of 0.5 m/KA, barrier and lagoonal associations predominate, while in the east, where uplift rates range

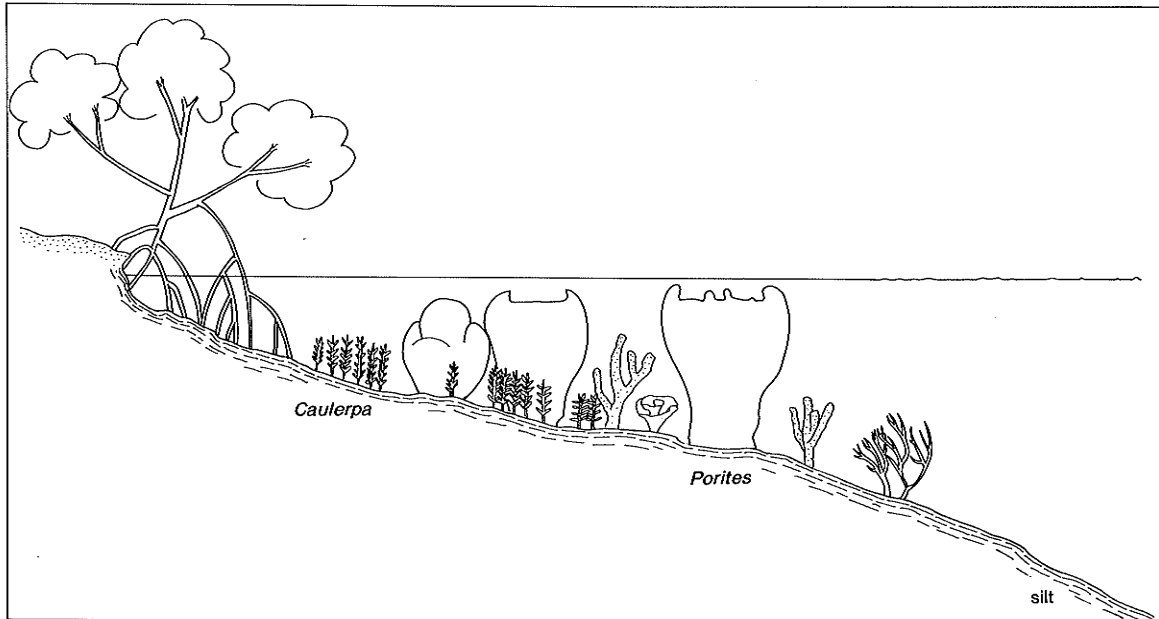


Fig. 6a. Schematic of the reef and island features of Madang Lagoon: back of Nagada Harbour and other similar inlets.

up to 2–3 m/KA, fringing reefs and gravel-built terraces predominate. In the Madang region an uplift rate of around 0.5 m/KA would tend to duplicate conditions in the western Huon terraces.

During maximal periods of rise, sea level would have risen between 8 to 17 m per thousand years (Chappell & Polach, 1976). Thus, if the barrier was formed during this period it would have been a truly remarkable rate of growth (Chappell, 1989). There is a possibility that the barrier may possess a Pleistocene core, but evidence for this is lacking.

Stratigraphic examination of the modern 3 m terrace around CRI by A. Tudhope (pers. comm., 1992) reveals a complex Holocene history. Two distinct layers are present in the terrace (Fig. 5). The boundary between these layers is characterised by a large number of massive micro-atoll corals. These suggest a period of relative stable sea level. In the upper layer there are numerous micro-atolls at differing levels, suggesting a pulsed rise in sea level over several centuries. Since eustatic sea levels have not been known to vary in this way (Chappell, 1974), the structure of these reefs can only be accounted for by localised tectonic subsidence or gravitational slumping in the Madang region (Tudhope, 1992).

This complex Holocene history may well account for the variation seen today in the combination of barrier reef and islands, as well as mid-lagoon islands and both deep (3–4 m) and shallow (<1 m) patch reefs. Differential silting adjacent to the Meiro, Nagada and Biges rivers have probably also been long term influences on reef growth.

Volcanoes

A string of volcanoes (e.g., Bam, Manam, Karkar, Bagabag, Crown Island and Long Island) lies along the tectonic boundary between the North Bismark Sea and the South Bismark Sea. These comprise the Bismark Volcanic Arc. The oldest of these volcanoes is about 5 million years old, and some remain active today. Many have a history of pyroclastic eruptions. Long Island contains a water-filled caldera about 8 km across which last erupted between 1800 and 1840 (Blong, 1982), depositing over 10 cm of ash on some parts of the Madang coastline (Blong, 1982). Dating of fossil, *in situ* Porites coral heads on Depilik Tabub suggests a date of c.200 years before present whilst living heads rarely exceed 150 years (A. Tudhope, pers. comm.). The relative abundance of these fossil heads, and their contemporary ages is highly suggestive that the Long Island eruption was the causative agent.

The eruption of Ritter in 1888 produced tsunamis that struck New Britain and the New Guinea mainland (Dow, 1977). Earthquakes can also have important impacts on the quantity of sedimentation and reef growth (Stoddart, 1972). An earthquake of force 8.2 on the Richter Scale, in the Madang area in 1972, led to landslides in which some catchments lost up to 60% of their vegetation (Johns, 1986). Other important climatic effects such as droughts and forest fires are also documented by Johns (1986). Cyclonic winds are virtually unknown on the Madang coastline (Johns, 1986).

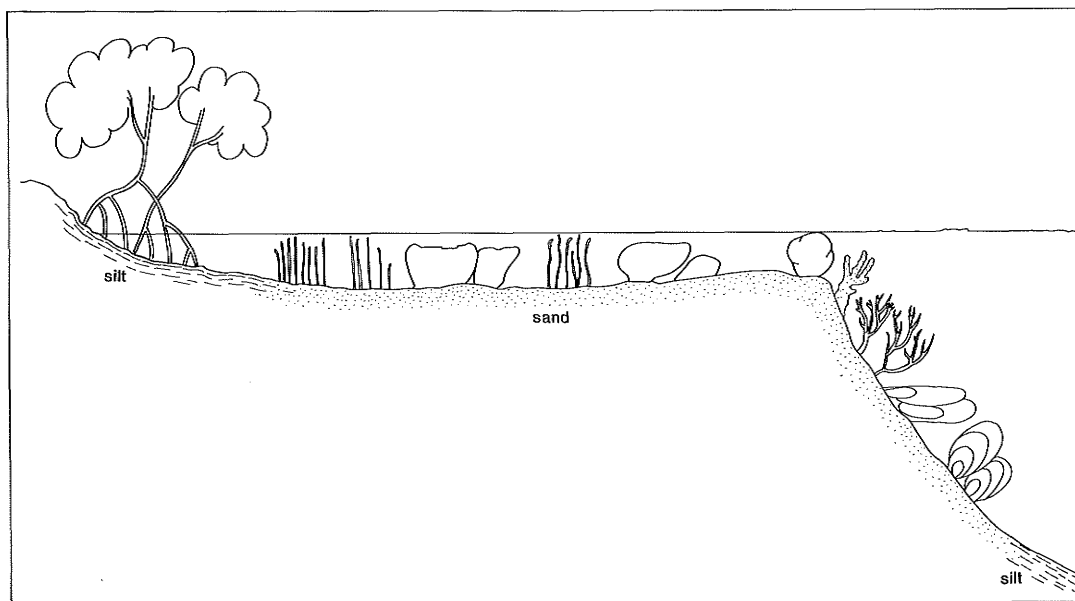


Fig. 6b. Schematic of the reef and island features of Madang Lagoon: fringing reefs at CRI.

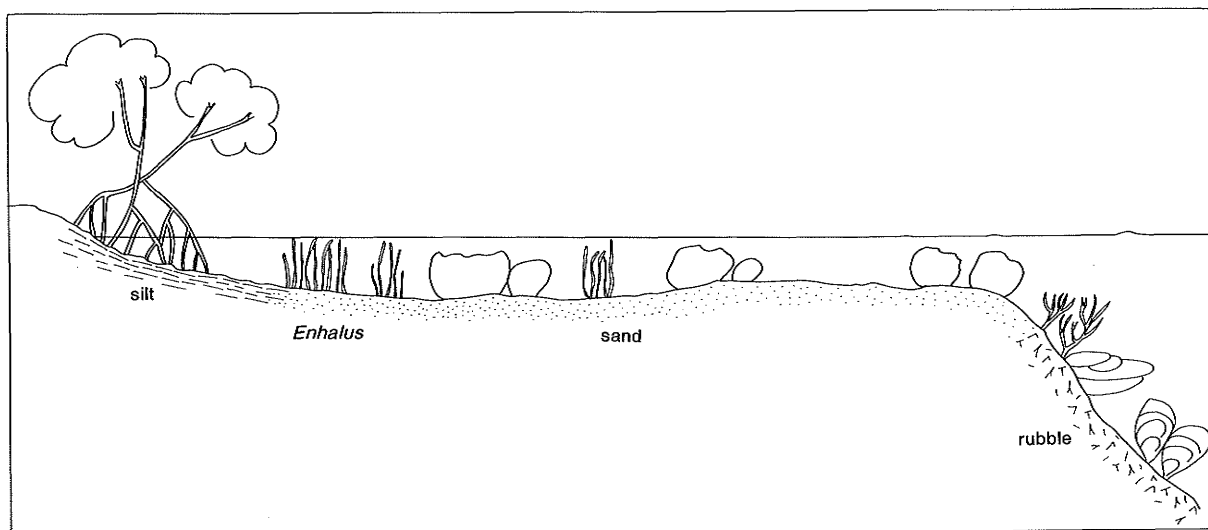


Fig. 6c. Schematic of the reef and island features of Madang Lagoon: sea grass beds.

Oceanography

The surface sea temperatures around the north coast of New Guinea are some of the highest known. These often reach 28°C, while temperatures in the lagoon in excess of 30°C in the top 2 to 4 m are commonplace. The thermocline may descend as far as 30 m on the outer

barrier reef. Temperatures of the water on the inner edge of the lagoon, at a depth of 4 m, vary from 27 to 29.5°C through the year, with a mean of about 28.3°C. Temperatures on the outer edge of the lagoon are about 0.5°C lower than on the inner margin (Tudhope, pers. comm. and 1992). Salinities are in the region of 33–35 ppt. Surface salinities drop after heavy rain, and may rise during warm still conditions.

Tides

Madang experiences a mixed semidiurnal tide. Tidal range varies between 0.2 and 1.1 m during an annual cycle. The mixed tide is dominated by a single high and low, with a variable mixed element, that tends to lie close to the high. Prolonged low tide levels can sometimes coincide with the middle of the day. Such a situation may explain the absence of tidal flats. Corals only appear above water level on 1 or 2 days of the year. Other structural features apparently missing from the Madang Lagoon in addition to tide flats are spur and groove formations on the outer barrier reef and algal ridges. A combination of changes in relative sea level and the particular tidal regime may account for this.

The Madang region is strongly influenced by the El Niño Southern Oscillation (ENSO) event. Rainfall varies greatly between adjacent years, from 2500 mm in dry years (1987, 1992) to 4500 mm in wet years (1990).

General Description of the Biological Habitats (Partly based on Oliver, 1988)

Mangrove Associations

Mangrove development is slight in the Madang region, as it is along the entire north coast of New Guinea. This is a consequence of the recent rapid changes in sea level and the lack of large estuarine deposits or deltaic build-ups. Two major mangrove areas occur behind Riwo and around the mouth of the Meiro River (see Fig. 2). Eighteen species of mangrove have been recorded (Rau, 1988).

Back of Nagada Harbour and other Similar Inlets

(Fig. 6a)

Coral cover ranges from 0–50%. The bottom consists of fine silt and clay grading to sand. In muddy areas *Caulerpa* and *Halimeda* dominate, with scattered coral heads of massive *Porites* and massive faviids. In clearer waters branching *Porites*, *Goniopora*, *Echinophyllia*, *Seriatopora* and *Fungia* also occur. Fish are chiefly pomacentrids. Towards the seaward end of the harbour the coral community increases in diversity dramatically.

Fringing reefs at CRI

(Fig. 6b)

At the mouth of Nagada Harbour, and along the sea front at Jais Aben Resort the reef flats are dominated by many faviids, branching *Montipora* and small

massive and branching *Porites*. At increasing depths branching *Acropora* and more numerous *Porites* coral heads are interspersed with some large, monospecific stands of *Montipora*, *Acropora*, *Echinopora*, *Leptoseris*, *Millepora*, *Pectinia*, *Seriatopora* and *Turbinaria*. Large gorgonians and sponges are also common. Over 300 common species of reef fish have been recorded here (Allen, 1987).

Sea Grass Beds

(Fig. 6c)

Just to the north of CRI lie large areas of shallow (1–2 m), well protected reef/rubble flats with scattered sea grass beds of *Enhalus acoroides*, interspersed with *Porites* coral heads. Other sea grasses recorded in the area include *Cymodocea serrulata*, *Halodule uninervis*, *Halophila ovalis* and *Thalassia hemprichii*. These beds support a diverse holothurian fauna (18 species) (Pearse, 1988). A network of mangrove-fringed islands and micro atolls make this an interesting mosaic of habitats.

Shallow patch reefs (Padoz and Mizegwadan Reefs)

(Fig. 6d)

These reefs are shallow (1 to 2 m), with dense coral cover (30–100%) of high diversity. Many species of massive faviids and large stands of *Acropora palifera* dominate the reef top. With increasing depths compact acroporas, plate-forming *Acropora*, *Pectinia*, and the soft coral *Sarcophytum* predominate. In addition *Fungia*, *Seriatopora* and soft corals become more numerous. The rear (lee) reef slope has a rubble crest, and a more gentle sand slope with occasional *Acropora* thickets. The other slopes consist of rubble merging into sand and then silt at depths of 20 m. Large gorgonians are commonly found at this depth around all lagoonal patch reefs.

Deep patch reefs (Mazamoz and Yazi Reefs)

(Fig. 6e)

These reefs, although in a corresponding position to the former two and within 2–3 km, are remarkably different. Their tops are much deeper, and have a sparser hard-coral cover (0–20%). The reef top is dominated by extensive soft coral communities of *Sarcophytum*, *Sinularia* and *Lobophytum*, as well as numerous gorgonians. Healthy hard coral growth is limited to a narrow depth range around the edges of the reefs, which consists of arborescent and tabulate species of *Acropora* and plate-like species of *Montipora*.

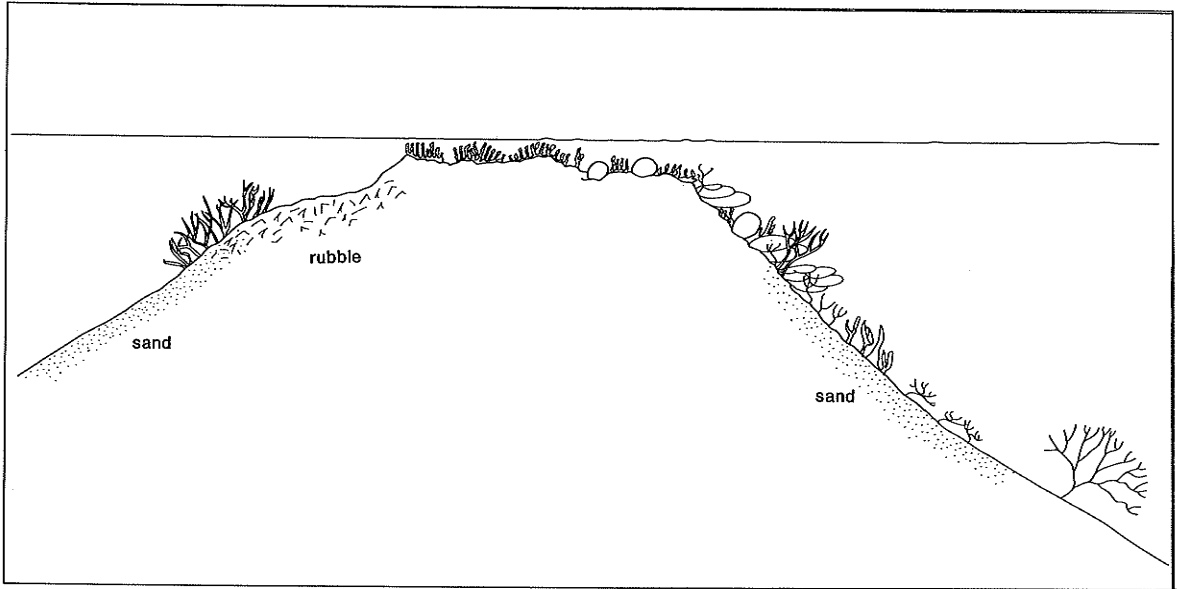


Fig. 6d. Schematic of the reef and island features of Madang Lagoon: patch reefs; view looking North, with seaward edge to right (Padoz and Mizegwadan Reefs).

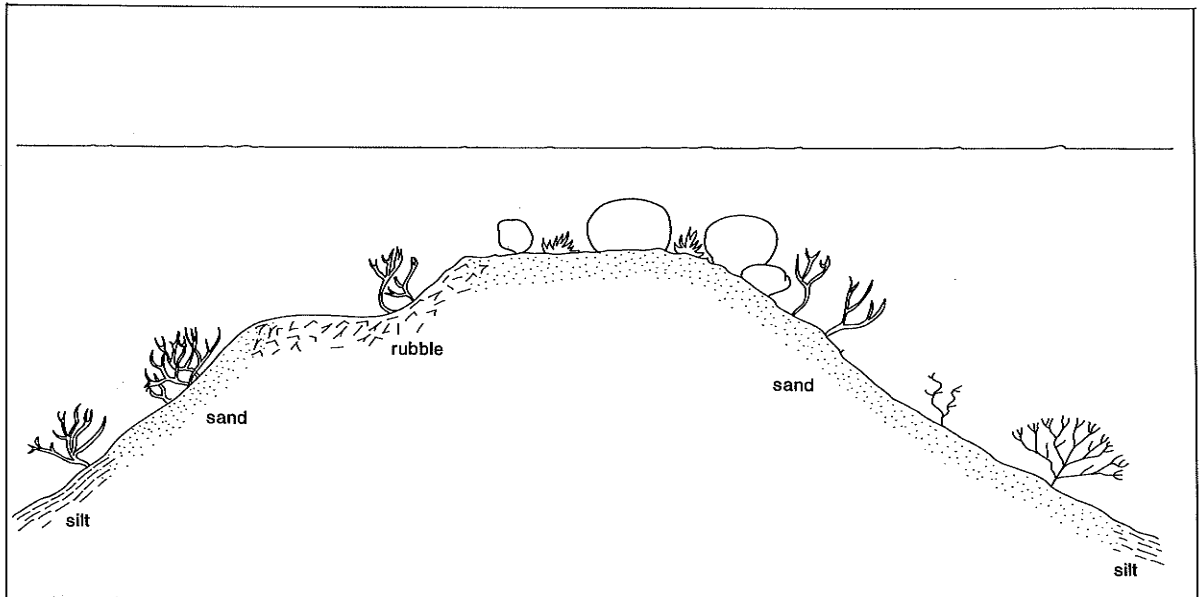


Fig. 6e. Schematic of the reef and island features of Madang Lagoon: patch reefs; view looking North, with seaward edge to right (Mazamoz and Yazzi Reefs).

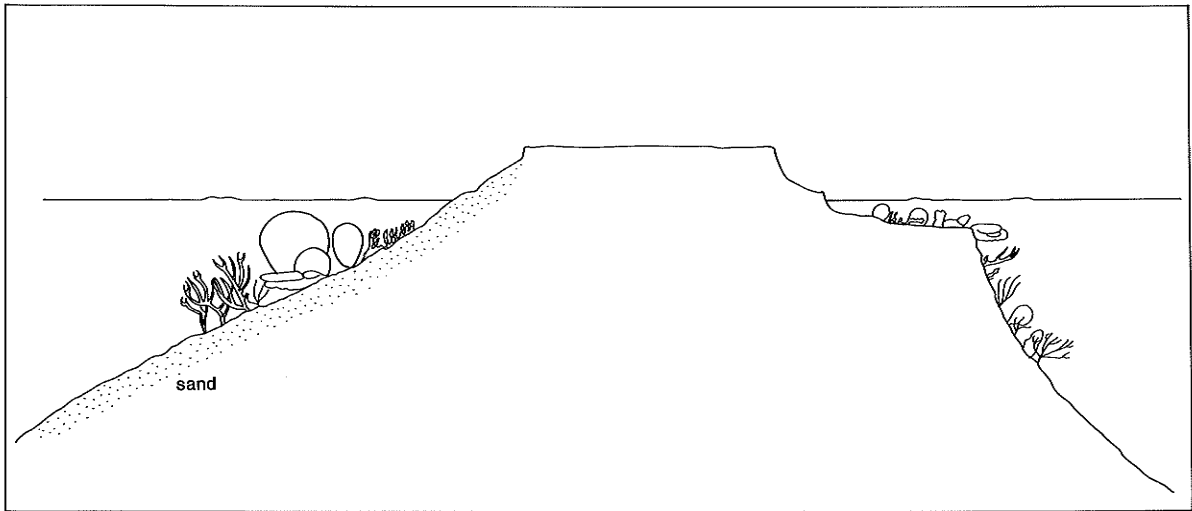


Fig. 6f. Schematic of the reef and island features of Madang Lagoon: Wongad, Tab, Mazzaz, Paeowai and Kranket islands. View looking North, with seaward edge to right.

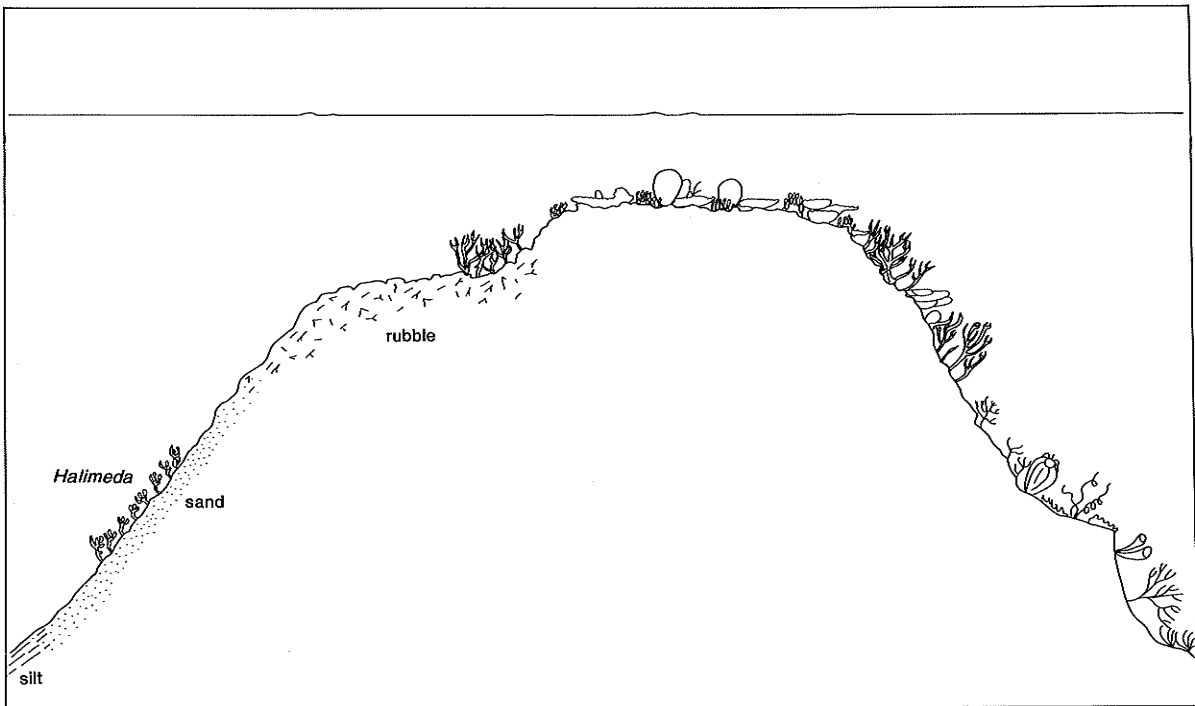


Fig. 6g. Schematic of the reef and island features of Madang Lagoon: the Barrier Reef. View looking North, with seaward edge to right.

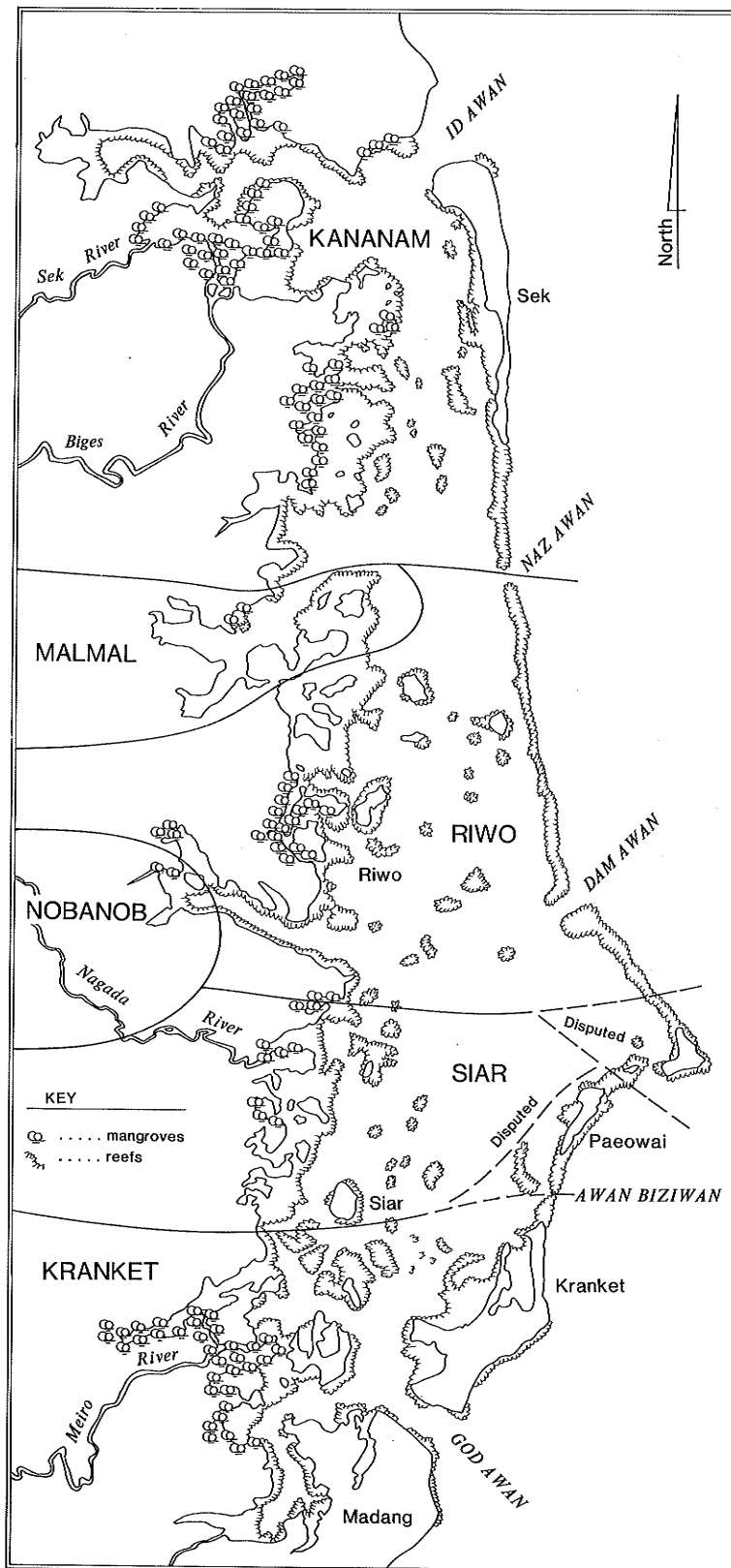


Fig. 7. Village groups (in Roman capitals) indicating current boundaries within the lagoon. (This map is based on conversations with members of Kranket, Siar and Riwo villages, and is in no way authoritative, and must not be used in determining ownership or traditional fishing rights.)

Large heads of *Porites* occur towards the centre of the reefs. The slopes of these reefs consist of rubble. They experience much greater wave action than the former reefs. Some of them have been dynamited for fishing. Explosives are obtained from WWII ammunition dumps around Alexishafen.

Wongad, Tab, Mazzaz, Paowai and Kranket islands

(Fig. 6f)

The inner side of patch reefs and mid-lagoon islands are broadly speaking, accreting faces, with gentle sand and *Halimeda*-flake slopes developing in the lee of the reef, generally the landward side. This sand slope may develop *Acropora* thickets or large *Porites* coral heads in more stable areas. The seaward side of these islands is characterised by a shallow fringing reef with an abrupt drop off at its extreme edge, similar to the fringing reefs of the mainland.

The Barrier Reef

(Fig. 6g)

The outer slope of the barrier reef varies between 45° and 70° and consists of a steep wall dissected by sand and rubble-filled canyons. Low sea-level terraces are visible at about 55 and 70 m depths, although these vary greatly from place to place. The reef top is narrow (20 to 70 m) and falls less steeply on the leeward side (20 to 45°). Coral cover on the reef top is high at the seaward edge (70 to 100%), declining with depth, and towards the landward margin. The top is dominated by compact branching *Acropora*, such as notably *A. palifera*. The abundance of *Stylophora* and tabulate *Acropora* increases with depth, and *Pachyseris*, *Montipora* and *Echinophyllia* become dominant below 20 m. Hard coral cover drops off in turn towards the lagoonal edge of the reef, to be replaced by a rubble bottom of 4 to 5 m depth which quickly becomes a steep talus slope with a rich cover of *Halimeda* in places. The slope is chiefly made up from *Halimeda* flakes, with a smaller quantity of coral fragments. This slope meets the lagoon floor at about 20 to 30 m and grades abruptly into the soft silty sediment. The talus slope is very unstable and this suggests a fast accretion rate. In more protected areas, such as behind Wongad and Tab islands, the slope is more stable and supports large populations of the foraminiferans *Alveolinella* and *Marginopera*. Lipps (1987) suggests that these areas are relatively stable (months to years) since foraminiferans cannot tolerate unstable surfaces.

Human Interactions with the Reefs

The Madang Lagoon is divided between five major village groups: Kananam, Malmal, Riwo, Siar and Kranket (Fig. 7). Certain areas are under dispute, and have been for probably hundreds of years (Miklouho-Maclay, 1977). Likewise, land and reef disputes are common among the Riwo clans, as population growth places more pressure upon land use and reef exploitation.

There are nine major clans in the Riwo area. Of these the Tabat and Bazimut clans are reputedly the oldest. They formerly divided the Riwo region between themselves. The arrival of more recent groups through migration and intermarriage have resulted in a denser mosaic of ownership, especially of the agricultural land the reefs adjacent to the mainland. Marriage is one of the major factors in territory disintegration. The reefs immediately adjacent to the major population centres are often disputed.

Modern versus Traditional Names

All reefs have local names. It seems sensible to continue to adopt these terms rather than names such as "Cement Mixer Reef" and "Tripod Reef", terms often unknown to the indigenous population. Two maps (Figs 2,3) are provided for the purpose of identifying the reefs, and to furnish a source map for future workers. *Tinan* means true or original, *Natun* means son of, or child, *Mal* is a reef, *Awan* is a mouth. For some features we have been unable to obtain a consistent name (for instance "Barracuda Point") and these have been retained as bracketed names in the list of stations.

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APPENDIX

Station list, Papua New Guinea

All coordinates not checked using a satellite global positioning system (GPS) are marked with an asterisk. All names are Riwo place names with English names bracketed.

- AAM/PNG-1 Kranket, Madang Lagoon, Papua New Guinea (5°11.34'S 145°49.47'E), among *Halophila ovale*, 1 m, A.A. Myers, 21 February 1990.
- AAM/PNG-2 just west of bar, Nagada River sandbar, (*5°10.4'S 145°48.40'E); muddy silt, large amount of organic matter, 1.0 m, J.D. Thomas, 26 February 1990.
- AAM/PNG-3 south shore of Tab (Pig Island) (5°10.31'S 145°50.32'E), turf of red alga, intertidal, A.A. Myers, 27 February 1990.
- AAM/PNG-4 south shore of Tab (Pig Island) (5°10.31'S 145°50.32'E), *Halimeda* and *Acropora* rubble, 1.0 m, A.A. Myers, 27 February 1990.
- AAM/PNG-5 in front of Madang Resort Hotel coral rubble and debris, 1 m, A.A. Myers, 28 February 1990.
- AAM/PNG-6 Kranket Lagoon (5°11.34'S 145°49.47'E), 1 m A.A. Myers, 28 February 1990.
- AAM/PNG-7 Lagoon in front of Christensen Research Institute, red crustose algae, 1 m, A.A. Myers, 29 February 1990.
- AAM/PNG-8 Kranket, sheltered bay (5°11.34'S 145°49.47'E), consolidated mud and mangrove litter (fully marine), 1.5 m, A.A. Myers, 27 March 1991.
- AAM/PNG-9 Kranket, sheltered bay (5°11.34'S 145°49.47'E), *Padina* sp., 1.5 m, A.A. Myers, 27 March 1991.
- AAM/PNG-10 Kranket, sheltered bay (5°11.34'S 145°49.47'E), *Caulerpa racemosa*, 1.5 m, A.A. Myers, 27 March 1991.
- AAM/PNG-11 Kranket, sheltered bay (5°11.34'S 145°49.47'E), *Halimeda* sp., 1.5 m, A.A. Myers, 27 March 1991.
- AAM/PNG-12 Kranket, sheltered bay (5°11.34'S 145°49.47'E), coral rubble, 1.5 m, A.A. Myers, 27 March 1991.
- AAM/PNG-13 channel between Riwo village and Riwo island, among sponges, 1 m, A.A. Myers, 31 March 1991.
- AAM/PNG-14 channel at north end of Jais Aben Resort (5°09.06'S 145°48.20'E), *Turbinaria* sp., 1 m, A.A. Myers, 2 April 1991.
- AAM/PNG-15 channel at north end of Jais Aben Resort (5°09.06'S 145°48.20'E), *Padina* sp., 1 m, A.A. Myers, 2 April 1991.
- AAM/PNG-16 channel at north end of Jais Aben Resort (5°09.06'S 145°48.20'E), coral rubble, A.A. Myers, 2 April 1991.
- AAM/PNG-17 channel at north end of Jais Aben Resort (5°09.06'S 145°48.20'E), *Padina* sp., 1 m, A.A. Myers, 3 April 1991.
- JDT/PNG-1 Padoz Natun reef (5°09.60'S 145°48.77'E), formalin wash of rubble, 3 m, J.D. Thomas, 7 January 1989.
- JDT/PNG-2 Padoz Natun reef (5°09.60'S 145°48.77'E), formalin wash of rubble with sponges and algae, J.D. Thomas, 8 January 1989.

- JDT/PNG-3 Padoz Tinan reef (5°09.53'S 145°48.88'E), formalin wash of clean rubble and one piece of circular, flat-topped coral with numerous sponges and ascidians on underside, 2 m, J.D. Thomas, 9 January 1989.
- JDT/PNG-4 Guzem (5°09.39'S 145°48.26'E), sand sample just in front of CRI, J.D. Thomas, 9 January 1989.
- JDT/PNG-5 Padoz Tinan reef (5°09.53'S 145°48.88'E), formalin wash of rubble sample from slightly deeper water, 3 m, J.D. Thomas, 10 January 1989.
- JDT/PNG-6 Wongad, reef in front of island (approximately 5°08.30'S 145°49.80'E), formalin wash of rubble at reef crest, 4 m, J.D. Thomas, 11 January 1989.
- JDT/PNG-7 Guzem (5°09.39'S 145°48.26'E), samples from the tops of ripples in about 1 m of water, sand coarse and mixed with coarse rubble, J.D. Thomas, 11 January 1989.
- JDT/PNG-8 small patch reef between Guzem and Jais Aben Resort, (5°09.39'S 145°48.26'E); wash of rubble, mainly broken off coral chunks and rubble, 1 m, J.D. Thomas, 13 January 1989.
- JDT/PNG-9 near Christensen Research Institute (CRI) pier, (5°09.36'S 145°48.00'E); fine to medium quartz sand, 0.3 m, J.D. Thomas, 14 January 1989.
- JDT/PNG-10 Padoz Tinan reef (5°09.53'S 145°48.88'E), near north-west margin of reef, formalin wash of rubble, 3 m, J.D. Thomas, 14 January 1989.
- JDT/PNG-11 Yazi Tinan reef (5°09.11'S 145°49.14'E), among breakers, rubble sample, 1 m, high wave energy, J.D. Thomas, 15 January 1989.
- JDT/PNG-12 back slope of Yazi Tinan reef (5°09.11'S 145°49.14'E), unconsolidated coral rubble, mainly finer-size fragments overlying a coral/algal sand base, 3 m, J.D. Thomas, 15 January 1989.
- JDT/PNG-13 Dagadugaban (B-25 site) (5°08.22'S 145°49.21'E), sediment sample from coral/algal mud, coarse *Halimeda* flakes with finer overlay of organic mud, 21 m, J.D. Thomas, 17 January 1989.
- JDT/PNG-14 Dagadugaban (B-25 site) (5°08.22'S 145°49.21'E), shallow upper floor layer devoid of specimens, J.D. Thomas, 18 January 1989.
- JDT/PNG-20 Guzem Natun reef (5°09.29'S 145°48.37'E), formalin wash of rubble, coral rubble, plates of *Acropora cytherea* upside down and algal-covered, J.D. Thomas, 24 February 1990.
- JDT/PNG-21 Padoz Natun reef (5°09.60'S 145°48.77'E), south-east of point in rubble area near margin of reef, sampled *Didemnum molle* and *Aplidium crateferum* (complex encrusting), J.D. Thomas, 25 February 1990.
- JDT/PNG-22 Yazi Natun reef (5°09.23'S 145°48.98'E), formalin wash of rubble from hard, elevated substrate, not in connection with bottom sediments, J.D. Thomas, 26 January 1990.
- JDT/PNG-23 commensals from sea whip, numerous *Maxillipius*, J.D. Thomas, 26 January 1990.
- JDT/PNG-24 Padoz (probably Natun), (5°09.40'S 145°49.4'E), formalin wash of attached rubble, hammered protruding humps and broke up overturned piece of *Acropora*, J.D. Thomas, 27 January 1990.
- JDT/PNG-25 Wongad Natun reef (5°08.31'S 145°49.36'E), formalin wash of rubble, 12–15 m, J.D. Thomas, 28 January 1990.
- JDT/PNG-26 Guzem Natun reef (5°09.35'S 145°48.43'E), formalin wash of rubble on western portion of reef, little live coral cover, mostly rubble, J.D. Thomas, 29 January 1990.
- JDT/PNG-27 deep water sample, 400 m, from Matthew Jebb.
- JDT/PNG-28 eastern face of Wongad Natun reef (5°08.31'S 145°49.36'E), sediment sample (24–27 m) and piece of submerged wood (15 m), small sample of wood contained *Tropichelura* and limnoriids, J.D. Thomas, 30 January 1990.
- JDT/PNG-29 eastern face of Wongad Natun reef (5°08.31'S 145°49.36'E), sediment sample from large sandy area on reef top, coarse coral/algal round, ripples 6–9 cm high, 5 m, J.D. Thomas, 31 January 1990.
- JDT/PNG-30 western most point of eastern arm on Kranket Lagoon, (5°11.34'S 145°49.47'E); sediment sample, fine detrital mud over coarse matrix of *Halimeda* and coral fragments, anoxic layer at 5–6 mm, sloping at approximately 30°, J.D. Thomas, 31 January 1990.
- JDT/PNG-31 Padoz Natun reef (5°09.60'S 145°48.77'E), *Maxillipius* off 2 types of gorgonians, about 20–23 m, J.D. Thomas, 1 February 1990.
- JDT/PNG-32 Mizegwadan (Tripod) reef (5°09.57'S 145°49.36'E), formalin wash of rubble from unknown depth, bottom mostly rubble and soft corals, very little live coral cover, 3–4 m, J.D. Thomas, 2 February 1990.
- JDT/PNG-33 north-west corner of Tab (Pig Island) (5°09.98'S 145°50.45'E); sediment sample from sand slope, taken in 2 parts, 6 and 21 m, J.D. Thomas, 4 February 1990.
- JDT/PNG-34 north-west corner of Tab (Pig Island) (5°09.98'S 145°50.45'E); sediment and algal covered rubble in sand, 45 m, J.D. Thomas, 4 February 1990.
- JDT/PNG-35 Malolo Beach, 27 km north of Jais Aben turn-off, (4°58'S 145°47'E); black volcanic sand beaches, sediment sample of fine sand just beyond first sand bar, 2 m, J.D. Thomas, 4 February 1990.
- JDT/PNG-36 barrier reef slope in front of Wongad (5°08.30'S 145°49.80'E); sand and rubble sample, sand mixed coarse *Halimeda* from steep slope at 36 m, rubble sample from 30 m, J.D. Thomas, 6 February 1990.
- JDT/PNG-37 (Barracuda Point), reef just east of Tab (Pig Island) (5°10.26'S 145°50.61'E), moderate current flow, extensive coral cover in shallower depths, sediment sample 36 m from isolated accumulations of *Halimeda* and mud, rubble sample from underlays and rubble, 27–30 m, J.D. Thomas, 8 February 1990.
- JDT/PNG-38 (Banana Rock) (5°10.39'S 145°50.16'E), "penny coral" *Fungia (Cycloseris) sinensis* bed, 27–33 m J.D. Thomas, 8 February 1990.
- JDT/PNG-39 Malolo Beach, (4°58'S 145°47'E); beachhoppers, 2 large shell vials, J.D. Thomas, 4 February 1990.

- JDT/PNG-40 Guzem reef, in portion of reef closest to Guzem (5°09.35'S 145°48.43'E), formalin wash of rubble, partially cemented rubble, broken pieces of overturned *Acropora* and partially cemented rubble pieces from shallowest section of reef, J.D. Thomas, 10 February 1990.
- JDT/PNG-41 Malolo Beach, (4°58'S 145°47'E); sediment sample from near-shore swash zone (just at drop-off) also some samples further out in 2 m of water, fine black silt with abundant organisms, mainly wood fragments, J.D. Thomas, 10 February 1990.
- JDT/PNG-42 north side of Awan Biziwan (5°11.05'S 145°49.70'E); single amphipod from yellowish-brown gorgonian, 21 m, J.D. Thomas, 11 February 1990.
- JDT/PNG-43 north side of Awan Biziwan (5°11.05'S 145°49.70'E); sediment sample, 36 m, J.D. Thomas, 11 February 1990.
- JDT/PNG-44 Guzem reef, just west of shallowest portion of reef top, (5°09.35'S 145°48.43'E); formalin wash of overturned rubble in sand and *Acropora* plates, 2.5 m, J.D. Thomas, 12 February 1990.
- JDT/PNG-45 Wongad natun reef, formalin wash of rubble, 3 m, J.D. Thomas, 13 February 1990.
- JDT/PNG-46 Padoz Tinan reef, rubble sample some from overturned plates of *Acropora*, two buckets of rubble from deep chipping—uncovering underlying areas of rubble with good growths, J.D. Thomas, 15 February 1990.
- JDT/PNG-47 (Barracuda Point), Tab (Pig Island) (5°10.26'S 145°50.61'E); sediment sample from isolated pockets of *Halimeda* and mud, 36 m, J.D. Thomas, 16 February 1990.
- JDT/PNG-48 Mizegwadan (Tripod) reef (5°09.57'S 145°49.36'E), formalin wash of rubble, 3–4 m, J.D. Thomas, 16 February 1990.
- JDT/PNG-50 Padoz Natun reef, rubble from centre of reef, some deep rubble under algal-covered layer, J.D. Thomas, 18 February 1990.
- JDT/PNG-51 near west end of Guzem reef (5°09.35'S 145°48.43'E), formalin wash of rubble, 2–3 m, J.D. Thomas, 19 February 1990.
- JDT/PNG-52 Padoz Natun reef (5°09.60'S 145°48.77'E), rubble sample from reef slope, mud and algae covered rubble, 12 m, J.D. Thomas, 20 February 1990.
- JDT/PNG-54 night dive (2000 hrs) on the *Coral Queen* (5°09.57'S 145°49.93'E), swarms of *Birubius*, 3–4 m in depth (bottom depth 28 m) J.D. Thomas, 20 February 1990.
- JDT/PNG-55 Kranket Lagoon, (5°11.40'S 145°49.48'E); formalin wash of rubble, low energy area, very little substantial rubble—very pliable, 4–5 m, J.D. Thomas, 21 February 1990.
- JDT/PNG-56 north-west coast of Tab (Pig Island) (5°09.98'S 145°50.45'E); sample 1 of silt-sized fraction, 6–8 m; sample 2, 21–24 m, with large clay-mud fraction on the surface, J.D. Thomas, 21 February 1990.
- JDT/PNG-57 gully in south entrance of Dam Awan (Rasch Passage) (5°09.27'S 145°49.86'E), rubble and sediment, J.D. Thomas, 22 February 1990.
- JDT/PNG-58 gully behind south entrance to Dam Awan (Rasch Passage) (5°09.27'S 145°49.86'E), sediment sample, mix of sediments, 12, 15 and 21 m, J.D. Thomas, 22 February 1990.
- JDT/PNG-59 barrier reef near Wongad (5°08.11'S 145°49.53'E), rubble, encrusted dead *Acropora* plates, also some pieces from caves and overhangs, 36 m and 21 m, J.D. Thomas, 22 February 1990.
- JDT/PNG-60 barrier reef near Wongad (5°08.11'S 145°49.53'E), sediment sample from front of reef slope, 42 m, *Halimeda* coral/algal accumulation with fine brownish silt upper layer, J.D. Thomas, 24 February 1990.
- JDT/PNG-61 Nagada River sandbar, (*5°10.4'S 145°48.45'E); sediment samples black silt with little organic matter, 0.6 m at high tide (could be exposed at low tide), definite freshwater layer noticeable on surface, J.D. Thomas, 26 February 1990.
- JDT/PNG-62 just west of bar, Nagada River sandbar, (*5°10.4'S 145°48.40'E); muddy silt, large amount of organic matter, 1.0 m, J.D. Thomas, 26 February 1990.
- JDT/PNG-63 Padoz Natun reef (5°09.60'S 145°48.77'E), *Maxillipius* from gorgonians, J.D. Thomas, 25 February 1990.
- JDT/PNG-64 south shore of Tab (Pig Island) (5°10.31'S 145°50.32'E), turf of red alga, intertidal, J.D. Thomas, 27 February 1990.
- JDT/PNG-65 south shore of Tab (Pig Island) (5°10.31'S 145°50.32'E), *Halimeda* and *Acropora* rubble, 1.0 m, J.D. Thomas, 27 February 1990.
- JDT/PNG-66 (Barracuda Point), Tab (Pig Island) (5°10.26'S 145°50.61'E), rubble sample from reef slope, dead plates of overturned *Acropora*, 13 m, J.D. Thomas, 28 February 1990.
- JDT/PNG-67 Padoz Natun reef (5°09.60'S 145°48.77'E), formalin wash of cemented rubble in shallow part of reef near centre and northern edge, J.D. Thomas, 28 February 1990.
- JDT/PNG-68 in front of Madang Resort Hotel coral rubble and debris, 1 m, J.D. Thomas, 28 February 1990.
- JDT/PNG-70 Dagadugaban (B-25 site) (5°08.22'S 145°49.21'E), *Maxillipius* from gorgonians, 23 m, J.D. Thomas, 1 March 1990.
- JDT/PNG-71 western margin of Guzem reef, (5°09.35'S 145°48.43'E); formalin wash of rubble, mainly encrusted *Acropora* rubble, 2 m, J.D. Thomas, 16 April 1991.
- JDT/PNG-72 Dam Awan (Rasch Passage) (5°09.27'S 145°49.86'E), coral rubble, previously dead encrusted *Acropora*, 30 m and 15 m, J.D. Thomas, 17 April 1991.
- JDT/PNG-73 Dam Awan (south Rasch Passage) (5°09.27'S 145°49.86'E), in line on reef front with Mizegwadan (Tripod) reef marker, fore reef slope, 2 pieces of *Acropora* rubble—overhanging, 2 separate pieces, 12–18 m, J.D. Thomas, 20 April 1991.
- JDT/PNG-74 north of Awan Biziwan (5°11.06'S 145°49.70'E); outer reef slope, coral rubble, 12–15 m, J.D. Thomas, 21 April 1991.
- JDT/PNG-75 Awan Biziwan, reef just out from south end of Paeowai (5°10.89'S 145°49.72'E); sand sample, 3 m, J.D. Thomas, 23 April 1991.
- JDT/PNG-76 south-east shore of Tab (Pig Island) (5°10.30'S 145°50.44'E); rubble, fairly high energy, wave-washed area, 3–4 m, J.D. Thomas, 23 April 1991.

- JDT/PNG-77 east side of Tab (Pig Island) (5°10.30'S 145°50.44'E), wave-washed coral pools, sample 1, formalin soak of *Amphiroa* clumps in standing pools; sample 2, rubble sample, 0–1 m, on wave-washed cliff face, J.D. Thomas, 27 April 1991.
- JDT/PNG-78 seaward side of Tab (Pig Island) (5°10.30'S 145°50.44'E), *Sargassum* in wave-swept pools, J.D. Thomas, 28 April 1991.
- JDT/PNG-79 south-east side of Wongad (5°08.16'S 145°49.36'E), soft bottom sediment sample on slope, coral/algal mud, 6 m, D. Coulombe, 30 April 1991.
- JDT/PNG-80 reef flat on south-east point of Wongad (5°08.16'S 145°49.36'E), formalin wash of coral knobs, some deep rubble dislodged by hammering, 1 m (low tide), J.D. Thomas, 30 April 1991.
- JDT/PNG-81 south-east point of Wongad (5°08.16'S 145°49.36'E), rubble from wave-washed area, 1 m, J.D. Thomas, D. Coulombe & S. Thomas, 1 May 1991.
- JDT/PNG-82 east side of Tab (Pig Island) (5°10.30'S 145°50.44'E), *Amphiroa* and other seaweeds in subtidal pools, J.D. Thomas, 1 May 1991.
- JDT/PNG-83 patch reefs at southern end of Wongad (5°08.19'S 145°49.35'E), 4–6 m, J.D. Thomas, 3 May 1991.
- JDT/PNG-84 New Year Bay, Bagabag, (lat. long. not recorded) on large bommie reef *Leucothoe commensalis* from the tunicate *Rhopalaea crassa* several large specimens and numerous smaller ones, 20 m, J.D. Thomas, 3 April 1991.
- JDT/PNG-85 southern end of Wongad (5°08.19'S 145°49.35'E), reef flat rubble, 1.2 m, J.D. Thomas, 2 May 1991.
- JDT/PNG-86 Mazamoz reef (5°08.56'S 145°49.09'E), east and north ends of Riwo (island), deep rubble sample from underlying flat *Acropora* pavement over the rubble underneath, 3 m, J.D. Thomas, 7 May 1991.
- JDT/PNG-87 north-east corner of Dam Awan (Rasch Passage) (5°09.27'S 145°49.86'E), encrusted *Acropora* plates on reef flat, 3 m, J.D. Thomas, 9 May 1991.
- JDT/PNG-88 south of Dam Awan (Rasch Passage) (5°09.53'S 145°50.12'E), Mizegwadan (Tripod) reef in line with CRI, *Acropora* rubble overhangs, 12–15 m, J.D. Thomas, 11 May 1991.
- JDT/PNG-89 Nagada River sandbar, (5°10.30'S 145°48.45'E), sediment just in front of bar at very low tide, 0.3 m, J.D. Thomas, 14 May 1991.
- JDT/PNG-90 north of Dam Awan (Rasch Passage) (5°08.59'S 145°49.65'E) half way between Wongad and passage opening, rubble, mainly algal covered, 27–30 m, J.D. Thomas, 16 May 1991.
- JDT/PNG-91 Nagada River sandbar (5°10.30'S 145°48.45'E); approximately 20 m west of shallow point of bar, sediment sample, from ripple areas with lots of organic matter, 1 m, J.D. Thomas, 21 May 1991.
- JKL/PNG-64 north side of Awan Biziwan, between Paowai and Kranket (5°11.06'S 145°49.70'E); tufted red alga (like a pot scrubber) on outer reef face, 10 m; J.K. Lowry, 20 January, 1990.
- JKL/PNG-65 north side of Awan Biziwan, between Paowai and Kranket (5°11.06'S 145°49.70'E); small hermit crab outer reef face, 10 m; J.K. Lowry, 20 January, 1990.
- JKL/PNG-66 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, pieces of wood, 40 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-67 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, pieces of old wood bored by molluscs, 12 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-68 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, black sponge, 12 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-69 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, many *Didemnum molle* with encrusting sponges on dead *Acropora* branch, 10 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-70 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, 40 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-71 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, 40 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-72 The Quarry, near the village of Bunu 2 (4°46.50'S 145°48'E), steep coral slope straight off the beach with large unstable rubble and sand, 40 m, J.K. Lowry, 21 January, 1990.
- JKL/PNG-73 back slope of Outer Barrier north of Dam Awan (Rasch Pass) (5°08.59'S 145°49.65'E), baited trap 1, small blocks of rubble (about 75% cover) over coarse sand with 2 kinds of *Halimeda*, a dictyotalean a *Caulerpa* and a large black holothurian, 15 m, J.K. Lowry, 22–23 January, 1990.
- JKL/PNG-74 back slope of Outer Barrier north of Dam Awan (Rasch Pass) (5°08.59'S 145°49.65'E), baited trap 2, small blocks of rubble (about 40% cover) over coarse sand with 1 kind of *Halimeda*, a dictyotalean and a sand anemone, 20 m, J.K. Lowry, 22–23 January, 1990.
- JKL/PNG-75 back slope of Outer Barrier north of Dam Awan (Rasch Pass) (5°08.59'S 145°49.65'E), baited trap 3, sparse coral rubble on a sand bottom, sparse *Halimeda* with a few crinoids and a tunicate similar to *Polycarpa*, a sand anemone, 25 m, J.K. Lowry, 22–23 January, 1990.
- JKL/PNG-76 back slope of Outer Barrier north of Dam Awan (Rasch Pass) (5°08.59'S 145°49.65'E), baited trap 4, sparse coral rubble on a sand bottom, sparse *Halimeda*, and a colony of *Goniopora*, 30 m, J.K. Lowry, 22–23 January, 1990.
- JKL/PNG-77 front of Guzem Natun reef (5°09.35'S 145°48.43'E), baited trap 2, sandy gully (rubble on sand) between dead *Acropora* and soft corals, 6 m, J.K. Lowry, 24–25 January 1990.

- JKL/PNG-78 front of Guzem Natun reef (5°09.35'S 145°48.43'E), baited trap 4, coarse sand bottom near dead between dead *Acropora*, living faviids and gorgonians, 13 m, J.K. Lowry, 24–25 January 1990.
- JKL/PNG-79 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 1, 90 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-80 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 2, 140 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990. no specimens.
- JKL/PNG-81 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 4, 240 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-82 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 5, 290 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-83 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 6, 340 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-84 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 7, 390 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-85 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 8, 440 m, J.K. Lowry, J. Mizeu and J.D. Thomas, 26–27 January, 1990.
- JKL/PNG-86 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 1, a lot of rubble, sponges and soft corals on a sandy bottom, 3 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-87 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 2, sandy bottom with coral rubble and a lot of sunken wood, 6 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-88 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 3, sandy bottom with large piece of wood and coconuts, 10 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-89 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 4, sandy bottom with some blue-green algal cover, sea pens, sunken wood, leaves and coconuts, 14 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-90 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 5, sandy bottom with some blue-green algal cover, sea pens, large synaptid, leaves and coconuts, 17 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-91 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 6, sandy bottom with some blue-green algal cover, leaves, 20 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-92 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 7, sandy bottom with some blue-green algal cover, sea anemone *Macroactyla doreensis* Quoy & Gaimard, 24 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-93 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 8, muddy sand bottom with some blue-green algal cover, coconut husks and worm tubes, 27 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-94 off beach, south-west side of Wongad (5°08.13'S 145°49.27'E), baited trap 9, muddy sand bottom with some blue-green algal cover and worm tubes, 30 m, J.K. Lowry & J.K. Elliott, 27–28 January 1990.
- JKL/PNG-95 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 1, sitting on a large *Porites lobata* and sandy patch in *Enhalus* bed, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-96 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 2, sitting near a small clump of *Stylophora* in a pure *Enhalus* bed on sandy bottom, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-97 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 3, sitting near coral rubble and small *Porites* and branching corals in a pure *Enhalus* bed on sandy bottom, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-98 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 4, in a pure *Enhalus* bed on sandy bottom, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-99 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 5, in an *Enhalus* bed near coral rubble, *Fungia*, *Stylophora* and branching soft corals, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-100 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 6, on *Porites* at edge of sandy patch *Enhalus* bed near coral rubble, a lot of soft corals, *Fungia* and *Diadema*, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-101 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 7, sitting near sandy patch and branching soft corals, 1 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-102 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 8, sitting on sandy patch surrounded by *Porites* and branching soft corals, 2.5 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-103 western side of Riwo channel (5°08.70'S 145°48.38'E), baited trap 9, sitting on a branching *Acropora* near *Porites lobata* 3 m, J.K. Lowry & J.K. Elliott, 29–30 January 1990.
- JKL/PNG-104 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 1, just off edge of sandy patch on top of reef, hard and soft coral cover, 3 m, J.K. Lowry & J.K. Elliott, 30–31 January, 1990.
- JKL/PNG-105 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 2, *Acropora*, branching soft corals and *Porites* 4 m, J.K. Lowry & J.K. Elliott, 30–31 January, 1990.

- JKL/PNG-106 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 3, dense cover of hard coral, *Porites* and *Stylophora*, 5 m, J.K. Lowry & J.K. Elliott, 30–31 January, 1990.
- JKL/PNG-107 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 4, sitting on branching *Acropora cytherea*, also branching soft corals and some *Halimeda*, 9 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-108 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 5, base of the reef, a lot of soft corals and *Turbinaria*, 17 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-109 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 6, small bommies of *Stylophora* and soft corals on a coarse sand bottom, 21 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-110 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 7, sandy mud bottom, some *Halimeda* and some soft corals, 24 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-111 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 8, sandy mud bottom, some *Halimeda* and some blue-green algal cover, 27 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-112 Wongad Natun reef (5°08.31'S 145°49.36'E), transect laid down front face of reef, dense coral cover to 17 m, baited trap 9, sandy mud bottom, and some blue-green algal cover, 29 m, J.K. Lowry & J.K. Elliott, 30–31 January 1990.
- JKL/PNG-113 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 1, 5.5 m, *Acropora* plates, *Porites*, *Stylophora*, *Halimeda* and small patches of coarse sand, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-114 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 2, 11 m, *Acropora* plates, *Porites*, *Stylophora*, *Halimeda* and small patches of coarse sand, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-115 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 3, 17 m, *Acropora* plates, *Porites*, *Stylophora*, *Halimeda* and small patches of coarse sand, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-116 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 4, 24 m, *Acropora*, *Stylophora*, *Goniopora*, a finely branched stinging coral and small patches of coarse sand, definite thermocline at the depth, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-117 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 5, 31 m, coarse sand bottom near hard bottom of ? *Montipora* sp., J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-118 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 6, 36 m, coarse sand bottom near hard bottom of ? *Montipora* sp., J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-119 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 7, 44 m, coarse sand bottom next to rock face with finger sponges and ? *Montipora* sp., J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-120 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 8, 51 m, coarse sand bottom next to vertical face of ? *Montipora*, and sponges, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-121 face of outer barrier between Dam Awan (Rasch Pass) and Wongad (5°08.59'S 145°49.65'E), baited trap 9, 59 m, a gently sloping coarse sand bottom near the vertical drop off, J.K. Lowry, J. Mizeu, 31 January–1 February, 1990.
- JKL/PNG-122 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 1, sand bottom with sparse *Caulerpa*, 0.5 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-123 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 2, sand bottom with sparse *Caulerpa*, 0.5 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-124 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 3, sand patch near hard coral, 1.5 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-125 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 4, coral rubble with living soft coral and a branching *Montipora*, 3 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-126 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 5, mostly coral rubble near large living *Acropora*, 7 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-127 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 7, soft mud bottom with some coral rubble, 15 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-128 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 8, soft mud bottom, 15 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.
- JKL/PNG-129 just east of the CRI pier, Nagada Harbour (5°09.36'S 145°48.00'E), baited trap 9, soft mud bottom, 16 m, J.K. Lowry & J.K. Elliott, 1–2 February 1990.

- JKL/PNG-130 encrusting yellow sponge with red surface on aft railings of the *Coral Queen*, Madang Lagoon, (5°09.57'S 145°49.93'E), 27 m, J.K. Lowry & S.J. Keable, 26 February 1991.
- JKL/PNG-131 erect branching grey sponge on aft deck of the *Coral Queen*, Madang Lagoon, (5°09.57'S 145°49.93'E), 27 m, J.K. Lowry & S.J. Keable, 26 February 1991.
- JKL/PNG-132 silty clay bottom with about 10% sand near the *Coral Queen*, Madang Lagoon, (5°09.57'S 145°49.93'E), 31 m, J.K. Lowry & S.J. Keable, 26 February 1991.
- JKL/PNG-133 next to hull of *Coral Queen*, port side, (5°09.57'S 145°49.93'E), baited trap 1 on muddy sand, 29 m, J.K. Lowry & S.J. Keable, 28–29 February 1991. (sediment sample A).
- JKL/PNG-134 10 m from hull of *Coral Queen*, port side, (5°09.57'S 145°49.93'E), baited trap 2 on muddy sand, 29 m, J.K. Lowry & S.J. Keable, 28–29 February 1991. (Sediment sample B).
- JKL/PNG-135 patch reef south-west of *Coral Queen*, (5°09.57'S 145°49.93'E), baited trap 3 on muddy patch reef, dominant coral *Montipora aequituberculata*, 29 m, J.K. Lowry & S.J. Keable, 28–29 February 1991.
- JKL/PNG-136 aft deck, starboard side of *Coral Queen*, (5°09.57'S 145°49.93'E), baited trap 4 on deck, 26 m, J.K. Lowry & S.J. Keable, 28–29 February 1991.
- JKL/PNG-137 fore deck, port side of *Coral Queen*, Madang Lagoon (5°09.57'S 145°49.93'E), baited trap 5 on deck, 26 m, J.K. Lowry & S.J. Keable, 28–29 February 1991.
- JKL/PNG-138 CRI Pier, (5°09.36'S 145°48.00'E); baited trap 6 on sandy bottom, 1 m, J.K. Lowry & S.J. Keable, 28–29 February 1991.
- JKL/PNG-139 10 m from port side hull of *Coral Queen*, Madang Lagoon, (5°09.57'S 145°49.93'E); dredge sample on muddy sand, 29 m, J.K. Lowry & S.J. Keable, 29 February 1991.
- JKL/PNG-141 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 1 on sandy bottom immediately adjacent to coral reef, 10 m, J.K. Lowry & S.J. Keable, 27–28 February 1991. (sediment sample 3).
- JKL/PNG-142 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 2 on sandy bottom 3 m from coral reef, 14 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-143 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 3 on sandy bottom not near and from coral reef, 19 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-144 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 4 at base of steep slope on coarse sandy bottom 2 m from small patch reefs, 23 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-145 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 5 next to small patch reef on coarse sandy bottom, 25 m, J.K. Lowry & S.J. Keable, 27–28 February 1991. (Sediment sample 2)
- JKL/PNG-146 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 6 next to small patch reef on coarse sandy bottom, 27 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-147 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 7 next to small patch reef on coarse sandy bottom, 28 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-148 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 8 on coarse sandy bottom next to *Lysiosquilla* burrow and about 3 m from small patch reef, 28 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-149 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 9 near edge of small patch reef covered in encrusting *Montipora* 28 m, J.K. Lowry & S.J. Keable, 27–28 February 1991. (Sediment sample 1).
- JKL/PNG-150 south-eastern corner of Tab (Pig Island) (5°10.31'S 145°50.32'E), baited trap 10 near edge of large patch reef covered in the agariciid coral *Pavona cactus*, 28 m, J.K. Lowry & S.J. Keable, 27–28 February 1991.
- JKL/PNG-151 innermost reach, north-west branch of Nagada Harbour (5°08.90'S 145°47.45'E), airlift sample of *Caulerpa* among corals on a silty bottom, 1.5 m, J.K. Lowry & S.J. Keable, 2 March 1991.
- JKL/PNG-152 innermost reach, north-west branch of Nagada Harbour (5°08.90'S 145°47.45'E), airlift sample of *Halimeda* among corals on a silty bottom, 1.5 m, J.K. Lowry & S.J. Keable, 2 March 1991.
- JKL/PNG-153 innermost reach, north-west branch of Nagada Harbour (5°08.90'S 145°47.45'E), sample of blue sponge on coral, 1.5 m, J.K. Lowry & S.J. Keable, 2 March 1991.
- JKL/PNG-154 innermost reach, north-west branch of Nagada Harbour (5°08.90'S 145°47.45'E), airlift sample of silty bottom, 3 to 6 m, J.K. Lowry & S.J. Keable, 2 March 1991.
- JKL/PNG-155 about 2 km off Rasch Pass, (5°09.40'S 145°51.1'E); baited trap, about 500 m, fine silty clay bottom (foraminiferal ooze), J.K. Lowry, S.J. Keable and M. Jebb, 9 March 1991.
- JKL/PNG-156 just off the southern tip of Tab (Pig Island) (5°10.31'S 145°50.32'E); (2000–2130), night light sample from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.
- JKL/PNG-157 just off the southern tip of Tab (Pig Island) (5°10.31'S 145°50.32'E); (2000–2130), night light sample from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.
- JKL/PNG-158 just off the southern tip of Tab (Pig Island) (5°10.31'S 145°50.32'E); (2000–2130), night light sample over the reef from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.
- JKL/PNG-159 just off the southern tip of Tab (Pig Island) (5°10.31'S 145°50.32'E); (2000–2130), night light sample from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.

- JKL/PNG-160 just off the southern tip of Tab (Pig Island) to about 1 km offshore (5°10.31'S 145°50.32'E); (2000–2130), 3 plankton samples, 1/3, 2/3, 3/3, from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.
- JKL/PNG-161 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), coarse sand and loose rubble, baited trap 1, 3 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-162 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), thick rubble and *Halimeda*, baited trap 2, 3 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-163 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), *Acropora* and loose rubble, baited trap 3, 4 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-164 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), coarse sand near *Acropora* and large garden of probably *Montipora aequituberculata*, baited trap 4, 9 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-165 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), soft corals and encrusting *Montipora*, baited trap 5, 14 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-166 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), soft corals and encrusting *Montipora*, baited trap 6, 18 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-167 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), sandy bottom near many small coral outcrops of encrusting *Montipora* and some large sponges, baited trap 7, 23 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-168 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), sandy bottom near many small coral outcrops of encrusting *Montipora* and *Seriatopora hystrix*, baited trap 8, 26 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-169 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), sandy bottom near many small coral outcrops of encrusting *Montipora*, baited trap 9, 28 m, J.K. Lowry & S.J. Keable, 2–3 March 1991. Trap damaged.
- JKL/PNG-170 Mizegwadan (Tripod) reef, (5°09.57'S 145°49.36'E), thin muddy bottom near many small coral outcrops of encrusting *Montipora*, baited trap 10, 29 m, J.K. Lowry & S.J. Keable, 2–3 March 1991.
- JKL/PNG-171 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), sandy mud bottom at foot of reef, baited trap 1, 30 m, J.K. Lowry & S.J. Keable, 5–6 March 1991. (Sediment sample).
- JKL/PNG-172 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), sandy mud bottom right at edge of reef, muddy coral outcrops, baited trap 2, 31 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-173 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, a burrowing holothurian, baited trap 3, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-174 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 4, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-175 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 5, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-176 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 6, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-177 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 7, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-178 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 8, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-179 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 9, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991.
- JKL/PNG-180 Mizegwadan (Tripod) reef towards northern tip of Paeowai (5°09.57'S 145°49.36'E), muddy bottom, many burrows, baited trap 10, 34 m, J.K. Lowry & S.J. Keable, 5–6 March 1991. (sediment sample).
- JKL/PNG-181 just off the southern tip of Tab (Pig Island) (5°10.31'S 145°50.32'E); (2000–2130), night light sample from the *Frohm*, J.K. Lowry, S.J. Keable and M. Jebb, 10 March 1991.
- JKL/PNG-182 channel between the outer barrier and Wongad (5°08.10'S 145°49.40'E), human dredge, sandy mud, 30 m, J.K. Lowry, and S.J. Keable, 13 March 1991.
- JKL/PNG-183 slope off back of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), loose rubble with *Padina* and a fine bushy red, 20 m, J.K. Lowry, and S.J. Keable, 13 March 1991.
- JKL/PNG-184 slope off back of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), loose rubble with *Padina* and a fine bushy red, 9 m, J.K. Lowry, and S.J. Keable, 13 March 1991.
- JKL/PNG-185 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), *Halimeda*, 6 m, J.K. Lowry, and S.J. Keable, 13 March 1991.
- JKL/PNG-186 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), compound ascidian *Lysielinum patella*, 6 m, J.K. Lowry, and S.J. Keable, 13 March 1991.
- JKL/PNG-187 beach at Wongad (5°08.13'S 145°49.27'E); intertidal sand and rock, baited trap sample, S.J. Keable, 13–14 March 1991.
- JKL/PNG-188 beach at Tabat (5°08.24'S 145°48.71'E); intertidal sand and rock, baited trap sample, S.J. Keable, 13–14 March 1991.
- JKL/PNG-189 small beach opposite Jais Aben Resort, (5°09.70'S 145°48.20'E); *Enhalus* beds and small patch reef, baited trap sample, S.J. Keable, 13–14 March 1991.
- JKL/PNG-190 small beach opposite Jais Aben Resort, (5°09.70'S 145°48.20'E); *Enhalus* beds and small patch reef, baited trap sample, S.J. Keable, 13–14 March 1991.

- JKL/PNG-191 near outer edge of the outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), dense *Acropora* plates, baited trap 1, 4 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-192 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), mostly living hard coral and patches of *Halimeda*, baited trap 2, 4 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-193 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), in a shallow depression of unconsolidated rubble, living coral within 2 m, baited trap 3, 4 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-194 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), baited trap hanging from coral outcrop on edge of shallow gully of rubble (probably a lot of baited trap movement) baited trap 4, 3.5 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-195 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), about half living hard coral and half unconsolidated rubble, baited trap 5, 3 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-196 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), about half living hard coral and half unconsolidated rubble, baited trap 6, 3 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-197 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), more than half living hard coral, mostly *Acropora* plates, small *Porites* (0.5 m diameter), blue *Linckia*, patches of *Halimeda*, a lot of *Didemnum molle*, unconsolidated rubble, baited trap 7, 3.5 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-198 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), more than half living hard coral, mostly *Acropora*, patches of *Halimeda*, a lot of *Didemnum molle*, unconsolidated rubble, baited trap 8, 3.5 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-199 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), large pieces of unconsolidated rubble, small outcrops of living hard coral, mostly plate *Acropora*, some clumps of *Halimeda*, baited trap 9, 3.5 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-200 top of outer barrier directly east of Wongad (5°07.98'S 145°49.51'E), large pieces of unconsolidated rubble, many crinoids, baited trap 10, 3.5 m, J.K. Lowry & S.J. Keable, 11–12 March 1991.
- JKL/PNG-201 top of outer barrier near back edge, directly east of Wongad (5°07.98'S 145°49.51'E), patchy hard and soft corals, about 50% cover, large pieces of unconsolidated rubble, *Halimeda* flake sediment, baited trap 1, 6 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-202 top of outer barrier near back edge, directly east of Wongad (5°07.98'S 145°49.51'E), patchy hard and soft corals, about 50% cover, large pieces of unconsolidated rubble, *Halimeda* flake sediment, baited trap 2, 6 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-203 top of outer barrier near edge, directly east of Wongad (5°07.98'S 145°49.51'E), small patches of hard corals, large pieces of unconsolidated rubble, *Halimeda* flake sediment, baited trap 3, 8 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-204 top of outer barrier at top of back slope, directly east of Wongad (5°07.98'S 145°49.51'E), unconsolidated rubble with *Padina* and some living *Halimeda* on *Halimeda* flake sediment, baited trap 4, 11 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-205 back slope of outer barrier, directly east of Wongad (5°07.98'S 145°49.51'E), unconsolidated rubble with *Padina* and some living *Halimeda* on *Halimeda* flake sediment, baited trap 5, 15 m, J.K. Lowry & S.J. Keable, 12–13 March 1991. sediment sample.
- JKL/PNG-206 back slope of outer barrier, directly east of Wongad (5°07.98'S 145°49.51'E), some rubble with living *Halimeda* on *Halimeda* flake sediment, baited trap 6, 20 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-207 back slope of outer barrier, directly east of Wongad (5°07.98'S 145°49.51'E), pure thick *Halimeda* flake sediment, baited trap 7, 24 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-208 back slope of outer barrier, directly east of Wongad (5°07.98'S 145°49.51'E), *Halimeda* flake sediment at bottom of slope, very large sponges, baited trap 8, 27 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-209 channel bottom directly between Wongad and the outer barrier towards Bagabag (5°07.98'S 145°49.51'E), some *Halimeda* flakes on sandy mud bottom with detritus layer, baited trap 9, 29 m, J.K. Lowry & S.J. Keable, 12–13 March 1991.
- JKL/PNG-210 channel bottom directly between Wongad and the outer barrier towards Bagabag (5°07.98'S 145°49.51'E), some *Halimeda* flakes on sandy mud bottom with detritus layer, baited trap 10, 29 m, J.K. Lowry & S.J. Keable, 12–13 March 1991. Sediment sample.
- JKL/PNG-211 among *Halophila ovalis*, 1 m CRI jetty (5°08.90'S 145°47.45'E); 14 March 1991, A. Myers.
- JKL/PNG-212 Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E); dead *Acropora* plates with epiphytes about 10 m, M. Jebb, 15 March 1991.
- JKL/PNG-213 Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), dead *Acropora* plates with epiphytes about 6 m, J.K. Lowry & S.J. Keable, 16 March 1991.
- JKL/PNG-221 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 1 on *Montipora* bottom, 12 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-222 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 2 on *Montipora* bottom, c. 23 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-223 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 3 on *Montipora* bottom, c. 34 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.

- JKL/PNG-224 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 5, over the edge, <65 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-225 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 6 unknown bottom, <85 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-226 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 8, unknown bottom, <205 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-227 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 9 unknown bottom, <265 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-228 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 10 on unknown bottom, <325 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-229 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 11 on unknown bottom, <385 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-230 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 12 on silty mud bottom, <445 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-231 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 13 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-232 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 15 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-233 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 16 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-234 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 17 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-235 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 18 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-236 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 19 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-237 1 km transect east from Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), baited trap 20 on silty mud bottom, about 500 m, J.K. Lowry & S.J. Keable, 15–16 March 1991.
- JKL/PNG-238 Padoz Natun reef (5°09.60'S 145°48.77'E), clumps of *Halimeda* attached to rubble held together by sponges, 2 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-239 Padoz Natun reef (5°09.60'S 145°48.77'E), anastomosing red alga forming mats on bottom, 2 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-240 Padoz Natun reef (5°09.60'S 145°48.77'E), coral rubble from top of reef, 1.5 to 2 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-241 transect between Padoz Natun reef toward the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 1 on hard rubble with *Porites* and *Acropora* plates near small sand patch (3 m diameter), 1.5 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-242 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 2 on hard rubble near *Acropora* plates, 1.5 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-243 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 3 sitting on large soft coral plate near *Porites* and *Acropora* plates, 1.5 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-244 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 4 sitting in a rubble depression near large soft coral plates and *Acropora* plates, 2 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-245 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 5 sitting among *Porites* and *Acropora* plates, 2 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-246 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 6 sitting among *Acropora* plates, some soft corals, 3 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-247 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 7 sitting among *Acropora* plates, *Stylophora*, *Turbinaria* an agariciid, probably *Pavona minuta* and some soft corals, 10 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-248 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 8 sitting among solid soft coral cover, over thin sediment and *Millepora* crust, 12 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-249 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 9 sitting on edge of coral outcrop among sea fans, soft corals and a rubble bottom, 16 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-250 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°48.77'E), baited trap 10, a lot of sea fans, soft corals and a sand/rubble bottom, 20 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-251 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 11, sitting on large coral outcrop between two large sea fans (one at least 2 m across), about 26 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.

- JKL/PNG-252 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 12, sitting on sandy mud sloping bottom near edge of reef, 32 m, J.K. Lowry & S.J. Keable, 17–18 March 1991. Sediment sample.
- JKL/PNG-253 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 13, sitting soft mud with small cones, many burrows and what looks like *Ampelisca* tubes on the surface, 35 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-254 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 14, sitting on soft mud with small cones, many burrows and what looks like *Ampelisca* tubes on the surface, 35 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-255 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 15, sitting soft mud with small cones, many burrows and what looks like *Ampelisca* tubes on the surface, 35 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-256 transect between Padoz Natun reef and the north end of Paeowai (5°09.60'S 145°49.77'E), baited trap 16, sitting soft mud with small cones, many burrows and what looks like *Ampelisca* tubes on the surface, 35 m, J.K. Lowry & S.J. Keable, 17–18 March 1991. Sediment sample.
- JKL/PNG-257 off the front face of Padoz Natun reef towards Paeowai (5°09.60'S 145°49.77'E), diver dredge at 40 m on soft mud bottom with small cones, many burrows and *Ampelisca* tubes on the surface, 35 m, J.K. Lowry & S.J. Keable, 17–18 March 1991.
- JKL/PNG-258 Awan Biziwan, (5°11.06'S 145°49.70'E), channel at bottom of reef face, rubble, 27 m, J.K. Lowry & S.J. Keable, 19 March 1991.
- JKL/PNG-259 Awan Biziwan, (5°11.06'S 145°49.70'E), rubble at top of reef, 3–10 m, M. Jebb, 19 March 1991.
- JKL/PNG-260 Awan Biziwan, (5°11.06'S 145°49.70'E), mat of sand tubes at base of reef, 27 m, J.K. Lowry & S.J. Keable, 19 March 1991.
- JKL/PNG-261 small rubble beach just across from CRI, (5°09.53'S 145°48.00'E), *Halophila ovalis* beds on sandy bottom in less than 1 m, J.K. Lowry & S.J. Keable, 20 March 1991.
- JKL/PNG-262 upper reaches of Nagada Harbour, Madang Lagoon, (5°09.53'S 145°48.00'E), sphaeromatid isopods burrowing tips of the aerial roots of the mangrove tree *Rhizophora stylophora*, M. Jebb, J.K. Lowry & S.J. Keable, 23 March 1991.
- JKL/PNG-263 reef top near Dam Awan (Rasch Pass) (5°09.27'S 145°49.86'E), overturned *Acropora* plates, small white vase sponges contained 3 species of leucothoid amphipod, 3 m, M. Jebb & J.K. Lowry, 16 January 1993.
- JKL/PNG-264 outside the reef near Dam Awan (Rasch Pass) (about 5°09.27'S 145°49.86'E), crabs from floating mats of seaweed, flotsam (coconuts, wood, etc.) and a one-celled green alga, G. Allen, G. Lowry & J.K. Lowry, 17 January 1993.
- JKL/PNG-265 outer reef face near Dam Awan (Rasch Pass) (about 5°09.27'S 145°49.86'E), shrimps and lobsters from rotenone station on mainly coral plate covered bottom, 10 to 20 m, G. Allen & J.K. Lowry, 17 January 1993.
- JKL/PNG-266 Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), large pieces of coral rubble, 20 to 25 m, M. Jebb, 18 January 1993.
- JKL/PNG-267 Planet Rock, Astrolabe Bay (5°15.48'S 145°49.14'E), crab from a giant neon pink anemone, 20 m, J.K. Lowry, 18 January 1993.
- JKL/PNG-268 dredge sample (pipe dredge) just south of Padoz Natun reef (about 5°09.60'S 145°48.77'E), 30 m, M. Jebb, J. Mizeu and J.K. Lowry.
- JKL/PNG-269 sand sample at The Quarry (*4°46.50'S 145°48'E), M. Jebb, 27 January 1993.
- JKL/PNG-270 rubble sample at The Quarry (*4°46.50'S 145°48'E), M. Jebb, 27 January 1993.
- JKL/PNG-271 face of outer barrier between Tab and Dam Awan (Rasch Pass), Rotenone station, 9–12 m, G. Allen & R. Steene, 28 Jan 1993.
- JKL/PNG-272 Padoz Natun reef (5°09.60'S 145°48.77'E), clumps of *Halimeda* and epiphytic algae attached to rubble held together by sponges, 8 m, D. Gochfeld, 15 December 1993.
- JKL/PNG-273 Padoz Natun reef (5°09.60'S 145°48.77'E), clumps of *Halimeda* and epiphytic algae attached to rubble held together by sponges, 8 m, D. Gochfeld, 2 January 1994.

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Jebb and Lowry, 1995, *Rec. Aust. Mus., Suppl. 22*: 1–24
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Myers, 1995, *Rec. Aust. Mus., Suppl. 22*: 25–95
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Lowry and Stoddart, 1995, *Rec. Aust. Mus., Suppl. 22*: 97–174
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Lowry, volume editor, 1995, *Rec. Aust. Mus., Suppl. 22*: 1–174
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