Flores to Alor

illustrated Field Notes 12-26 May 2023

Rodney V. Salm
7th September, 2023

INTRODUCTION

This document is a record of informal observations on coral community health and resilience made east of Flores Island to Alor Island and the Pantar Strait from Kaimana to Ambon. The observations were made between the 12th and 26th May 2023 during 26 dives and six snorkelling excursions. They are unapologetically the records of a coralophile pursuing his hobby and trying to improve understanding of why some reefs survive stress better than others. Consequently, fishes and critters suffered some neglect. Although opportunistic, useful reef health and resilience observations were possible that tell part of the story of what we observed.

We dived and snorkelled coral communities in a range of locations from deeply sheltered, silty water in bays to others that were highly exposed to strong currents and waves and storm surges coming out of the northwest. The following maps show the locations of the sites we visited.

Feather stars, Ipet

ACKNOWLEDGEMENTS

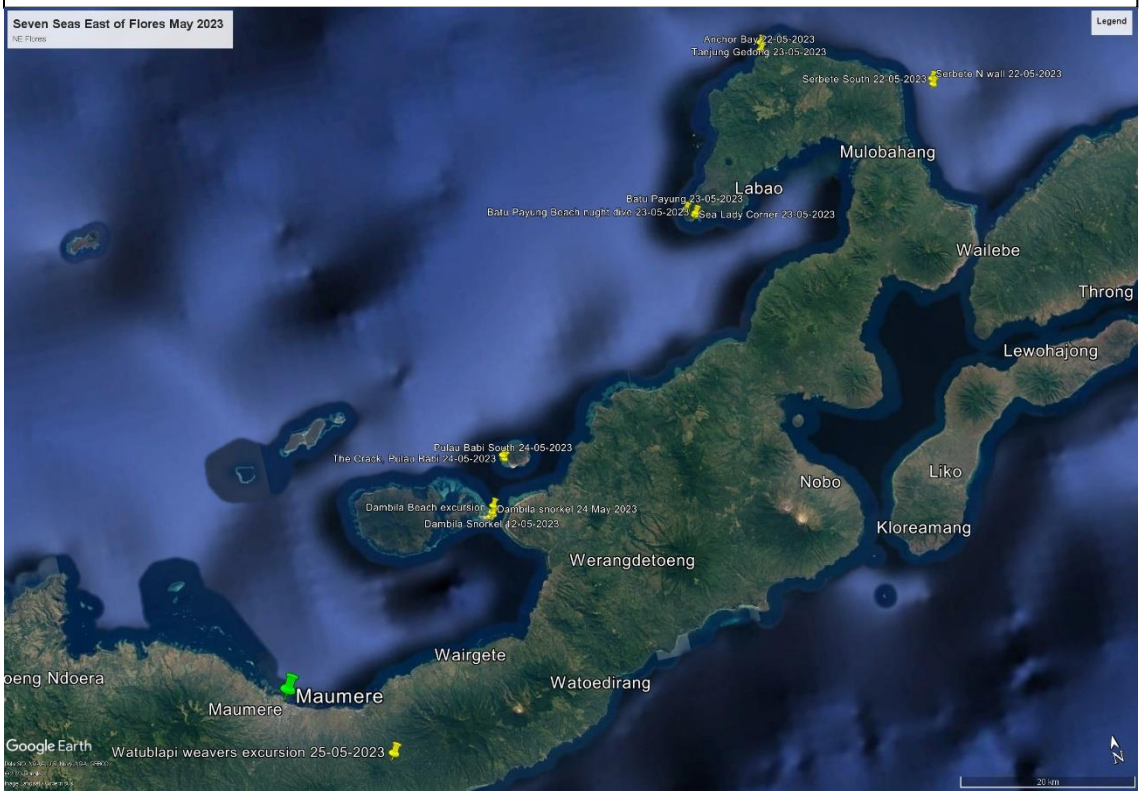
Special thanks to all the efficient, caring, and capable crew of the Seven Seas, including Captain Wahyu and Cruise Director Foued, dive leaders Foued, Jefry and Alex, and snorkel leaders Egoi and Imam for exceptional dive and snorkel experiences, and diligent attention to our needs, comfort, and safety. All crew members, including those seldom seen behind the scenes, contributed to a remarkable experience and their efforts are gratefully acknowledged. Thanks too to Mark Heighes and Alec del Olmo for your reconnaissance of exciting new dive sites to which early onset of the El Niño and Southeast Trades regrettably barred our access. Finally, to all fellow travellers, you were great company and conversationalists, interested in all we saw and did, and contributed so much to our experience, including, Suze, Charles, Peter, Ove, Fran, Danny, Wendy, Jan, Kim, Heidi, Mim, Wayne, and Dianne.

Soft coral *Sinularia*, Watupeni

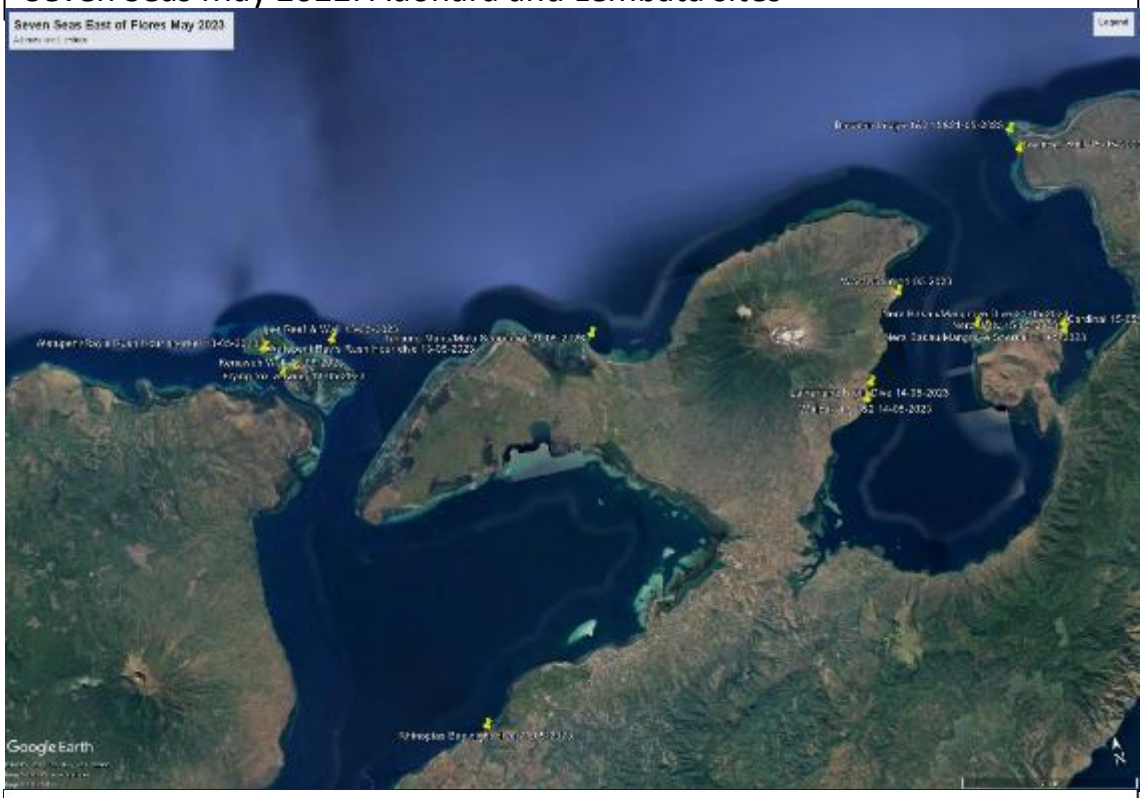
Juvenile batfish, *Platax*, Watupeni

Seven Seas May 2023: Flores Island to Alor Island and the Pantar Strait,

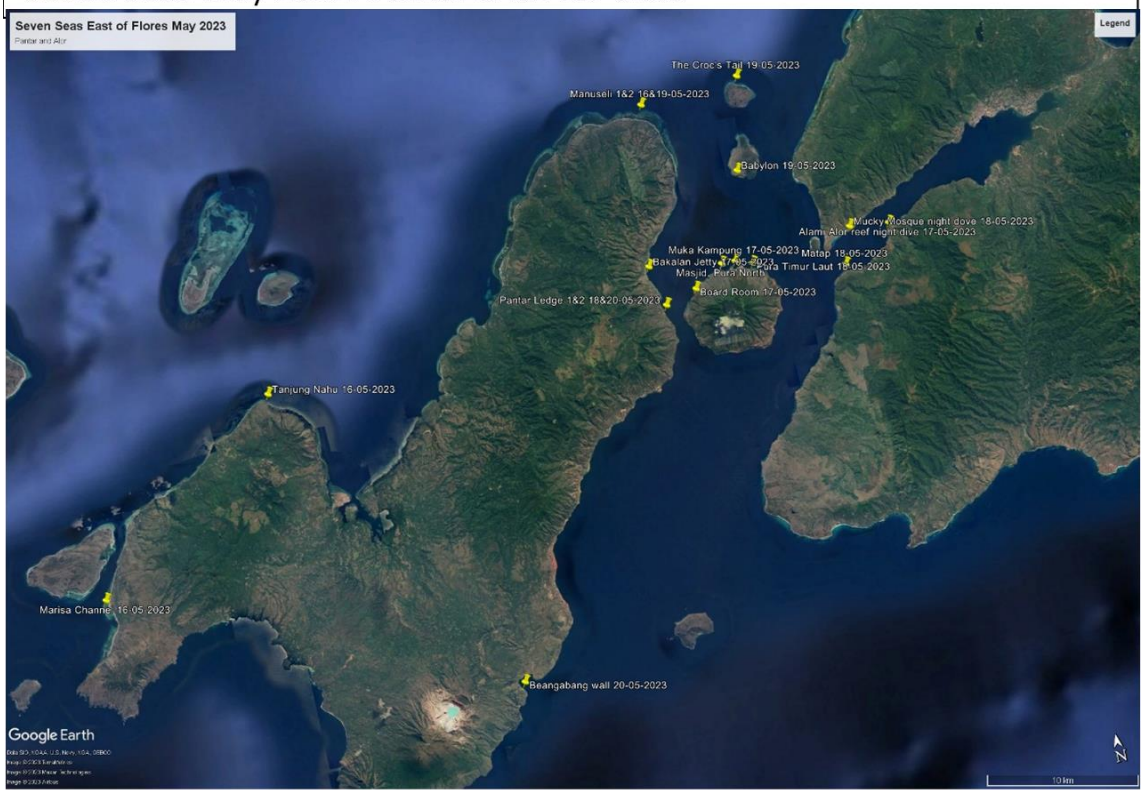
Seven Seas Mav 2023: NE Flores



Seven Seas May 2022: Adonara and Lembata sites



Seven Seas May 2022: Pantar and Alor sites



SUMMARY FINDINGS

There were considerable differences among the sites we visited. Some areas were selected specifically for their fish life and had strong currents, walls or pinnacles. Other areas were selected specifically for their host of unusual "critters," and had a sandy-rubbly substrate as at Matap, Alor, or jetties, such as at Bakalan, Pantar, and night dives in which I did not participate. Differences existed among the many coral reef sites. Some sites had scattered corals on a rocky substrate and no real reef framework. Other sites supported vibrant coral growth and underlying true reef framework development.

Except for areas impacted by fish traps and mooring lines, there was little other damage observed that could be unequivocally attributable to people (e.g., blast fishing, other destructive fishing, diver damage). Disturbance in some locations was often old and difficult to pin to a cause. The damage could have resulted from any of these observed causes: heat stress and bleaching, typhoons, earthquakes and tsunamis, predation by crown-of-thorns starfish (*Acanthaster planci*), and to a lesser extent pincushion starfish (*Culcita*), or the predatory *Drupella* snail, coral disease, or destructive fishing methods. However, the increased prevalence of the coral killing sponge, *Terpios hoshinota*, that has broken out to encrust and kill corals over large areas in a few coral communities is disturbing and a concern.

Indonesia is a seismically active country and several reefs have sustained major cracks through at least 20 metres of the reef framework as we witnessed at The Crack, Pulau Babi. Even lesser earth movements can shake corals off their pedestals causing them to topple or overturn and even to roll down the reef slope leaving a swathe of destruction behind them as happens with the yellow finger coral, *Porites cylindrica*. Toppled and overturned corals were regularly seen throughout this seismically active part of the "Ring of Fire," especially in the shadow of the restless volcano Gunung Api Lewotolok on Lembata Island.

Generally speaking, the sites we visited had high coral cover, diverse hard coral assemblages, large old corals, deep coral colouration, and active growth margins. Of the less developed coral communities, some exhibited strong recruitment of hard corals and rapid growth. While the corals at most sites seemed mildly susceptible to the current levels of heat stress, their stress resistance and recovery potential was generally moderately strong. The overall stress resilience outlook for many of these coral communities was moderately high. One interesting feature was the lack of large table *Acropora* and massive corals compared to sites further east through the Forgotten Islands and north into the Banda Sea. It was unusual for either of these corals to exceed three metres in size. Yet even these have suffered partial mortality, up to at least 80% for some colonies, indicating occasional severe stress events over the centuries.

Large fishes were noticeably scarcer than during previous visits over the years. We saw few if any large giant trevallies, dogtooth and yellowfin tuna, Spanish mackerels, schooling barracudas, and groupers.

There is much room for hope and optimism that continuing management efforts, which have already produced remarkable results, especially control of blast fishing and recovery of turtles and reef sharks, will aid recovery of these coral reef communities and enhance their resilience potential.

What follows is an overview of the health and resilience indicators I recorded, and the locations and illustrated notes for each site I dived or snorkelled.

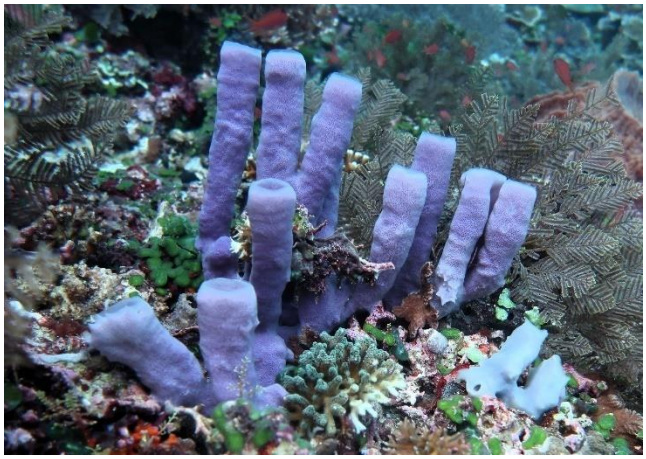
The sites we visited had varying, sometimes exceedingly high, live hard coral cover, diverse hard coral assemblages, deep coral colouration, and active growth margins. As can be seen in the following table that summarises the stress resistance, recovery, and overall resilience assessment for each site, 11 coral

communities had highest health and resilience potential, ten had moderate health and resilience potential, and the remaining eight were all ranked low resilience.

Seventy nine percent of the coral communities exhibited strong recruitment of hard corals and active colony growth. The remaining 21% exhibited moderately strong recruitment. This provides much hope and optimism for the recovery of reefs under a regimen of effective stewardship such as seen in many other parts of Indonesia.

Yellow scroll coral, *Turbinaria reniformis*, The Cardinal

Blue margin table *Acropora*, Pantar Ledge



Blue tube sponge, *Niphates olemda*, Pantar Ledge

Healthy branched table *Acropora*: good colour, Pantar Ledge

Stress resistance, recovery and overall resilience scores for all sites

Sites	Resistance Total	Recovery Total	Resilience total
Ipet reef & wall	43	16	62
Masjid Pura	42	16	62
The Croc's Tail	43	15	61
Marisa Channel	45	12	59
Pantar Ledge 1&2	43	13	59
Tg Batu Payung	43	13	59
Manuseli	42	15	59
Kenaweh	42	14	59
Beanggabean Wall			
Waipukang 1&2	41	15	59
Pura Timur Laut	41	15	59
The Cardinal, Nera	38	11	56
Serbete Wall N	42	10	55
Babylon, Reta	42	9	55
Serbete Wall S	41	10	53
Anchor Bay	40	11	53
Tanjung Gedong	40	11	53
P. Babi, The Crack	41	9	53
Warawutun	38	12	53
Tanjung Munu	39	10	52
P. Babi S	39	10	52
Bacatan, Ledge	37	9	50
Watupeni dive	34	11	49
Watupeni snorkel	37	9	49
Matap	37	9	49
Tanjung Nahu	41	5	48
Bacatan Wall	37	7	47
Dambila snorkel	35	9	47
Lady's Corner	36	8	46
MAX	45	16	62
MIN	34	5	46
RANGE	11	11	16
	41.33	12.33	56.67
	37.67	8.67	51.33
Values binned (high, medium, low)	High= >41; Mod=38-41; Low=<38	High= >12; Mod=9-12; Low=<9	High= >57; Mod=51-57; Low=<51
*High resilience = Max – Range/3; Moderate resilience = <High & >Low; Low resilience = Min + Range/3)			

Natural cycles of life, death, recovery, and reef growth

It is a common misconception in Indonesia and some other countries where fishing with explosives (blast fishing) occurred, or still occurs, that damaged coral is the always the result of this destructive practice. In reality there are several natural cycles of death and recovery in coral reefs. These may have beneficial consequences. Large monospecific stands of coral, such as we saw, dominated by branching *Acropora*, for example Manuseli, blunt finger coral *Porites cylindrica*, for example The Cardinal, stout branching catch bowl coral, *Isopora palifera*, for example Bacatan Ledge, and various species of foliose corals are vulnerable to predators and diseases. There is resilience in the diversity that occasional mortality events can achieve. Under healthy conditions, such intermittent disturbances kill off parts of coral communities making them available for settlement by other species and, in this way, promote diversity and resilience.

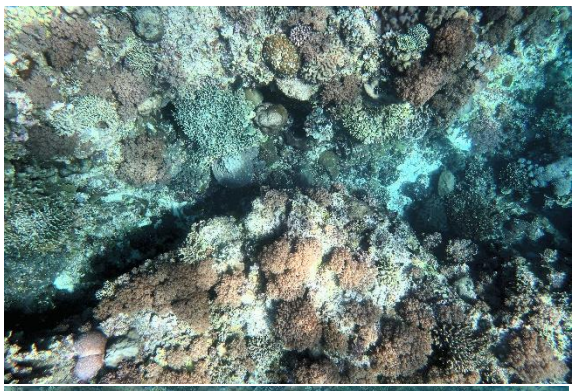
When conditions favour vigorous coral growth, coral colonies may grow out over the reef slope and break off under their own weight, creating holes, caves, and overhangs in the reef. These provide both shelter for a variety of organisms and also opportunities for other coral species to recruit to the dead coral surfaces thus exposed. Large chunks of coral colonies broken off in this way can roll downslope smashing corals in their path and stopping only when they reach the sandy sea floor at the reef's edge. In this way the reef extends itself seaward in a classic display of outward reef growth. This was best expressed at The Cardinal.

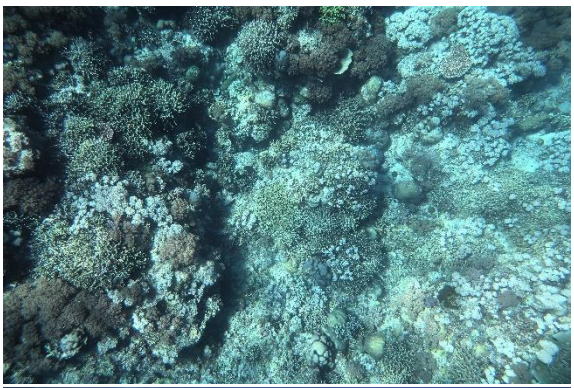
Indonesia is a seismically active area and earthquakes do shake corals off their pedestals toppling or even totally overturning them. Healthy corals are able to source energy from their fat deposits to cope with such extreme stress. They reattach to the substrate and alter their planes of growth to adjust to their new orientation. Extreme earthquakes have been known to split the reef framework and underlying rock to form chasms that extend 20 or more metres through the reef structure, breaking off huge chunks of reef rock and sending it tumbling down slopes and crashing down walls. In one extreme case, an entire coral reef conservation area off northwestern Sumatra was elevated above sea level.

We were fortunate to see very impressive different displays of such catastrophic reef damage and recovery: large cracks through the underlying reef framework at The Crack, Pulau Babi, and cleavage of blunt finger coral colonies, *Porites cylindrica*, and their collapse down the reef slope at The Cardinal. Here we witnessed how this process contributed to increased coral diversity and outward reef growth. We also saw numerous examples of large table and massive coral colonies shaken off their pedestals and toppled or even totally overturned, especially in the vicinity of the volcano Gunung Api Lewotolok. We also experienced the sharp reports of volcanic eruption from this volcano while diving, which was thought at first to be caused by blast fishing.

The following series of photographs taken during our trip demonstrate these processes at work.

Splitting of the reef framework

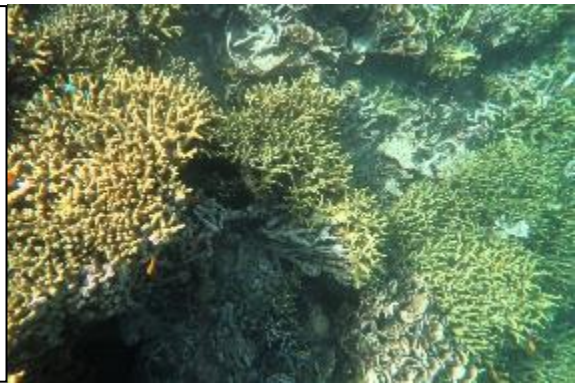




Wide and narrow cracks in the reef shelf and breakage and falling away of substantial portions caused by earthquake activity are a feature of the Tanjung Batu Payung reef (top four photos) and at Pulau Babi where the bottom photo shows a narrow crack through the reef.

Cleavage of coral colonies

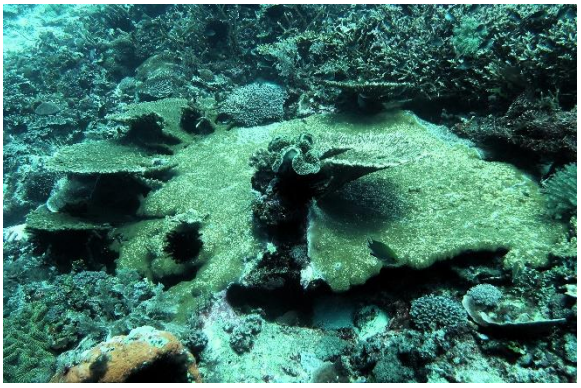
Cleavage and collapse of the blunt finger coral colonies, *Porites* cylindrica, can damage other corals when large chunks roll down the reef slope, The Cardinal



Toppled and overturned coral colonies

Colony survival and growth plane reorientation in toppled table *Acropora*, Masjid Pura (left) and Serbete Wall South (right)

Large boulder *Porites* has survived overturning, reoriented its growth plane, and provided dead surfaces for other corals to settle, Pura Timur Laut



Colony survival and growth plane reorientation in overturned table *Acropora*, Masjid Pura

CORAL HEALTH AND RESILIENCE INDICATORS

The resilience of a coral community has two principal and essential components: the ability to ***resist*** stress and the ability to ***recover*** from it. To assess these, I attempted to make observations of the following specific indicators of:

Coral stress resistance:

- temperature range and degree of mixing of the wager column
- depth of colour (or lack thereof) of coral colonies
- percent hard coral cover
- presence and width of active growth margins on table, branching, and foliose corals
- maximum size of table (stress susceptible) and massive (stress resistant) coral colonies
- range of size classes for table *Acropora* colonies

Coral stress recovery:

- evidence and strength of coral recruitment
- coral lesion repair
- coral regrowth over dead portions of the colony
- reorientation in the plane of growth for toppled or overturned coral colonies
- extent of substrate cover by turf algae
- presence and extent of substrate cover by macroalgae
- extent of substrate cover by sponges
- presence and extent of cover by crustose coralline algae

Coral health:

- presence and type of coral diseases
- presence and type of coral predation
- Coral infestation by burrowing organisms.

Based on what I acknowledge were incomplete observations, I estimated resilience potential for the coral community at each site based on the listed indicators. There was little evidence of recent coral bleaching-related coral mortality. This was a good sign, especially given the very strong 2015-16 El Niño years and elevated heat levels since 2020. It remains to be seen what 2023 will bring given the breaking heat records everywhere.

Stress resistance indicators

Coral colour

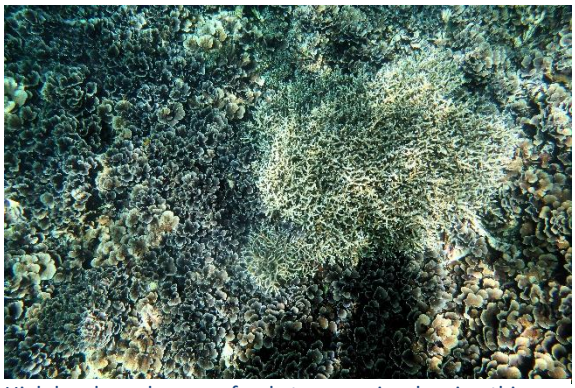
Deep colours in different coral taxa usually indicate healthy and stress-free coral colonies. Stress causes corals to lose colour leading to paling and brightening of coral colonies and eventually to mass coral bleaching and mortality if this is taken to extreme levels, such as we are seeing with warming seas.

Deep, healthy hard coral colouration, Pantar Ledge

Brightening colour is a prelude to coral bleaching in this stress susceptible *Seriatopora*, Ipet

Live hard coral cover

High live coral cover of diverse species indicates prolonged and consistent conditions favouring the health and strong growth of coral colonies, enabling them to occupy all available space, and suggests that such coral communities exist in relatively stress-free conditions year after year.



High hard coral cover of only two species, leaving this community vulnerable to stressors like heat stress, disease or crown-of-thorns starfish predation. Pura Timur Laut

High live hard coral cover of diverse species leaving this community more resilient to stressors, Manuseli

Growth margin

A wide active growth margin indicated by a pale border to coral colonies, especially branching, table, and foliose corals, indicates that the coral is thriving, healthy, has good growth and recovery potential, and is relatively stress-free.

Wide growth margins of branching and table *Acropora* (left and centre) and foliose *Turbinaria* coral colonies (right)

Maximum table coral size

Table *Acropora* corals are susceptible to many kinds of disturbances including heat stress associated with warming seas, storm surges, and a range of damaging people practices, such as anchoring, trampling, and destructive fishing. The presence of large old table corals tells us that conditions have been relatively free of stress for as long as the corals take to achieve their current size. We can use this to assess the extent and impacts of prior heat stress events on the corals at any location. Large old corals also produce more larvae that are essential for reef recovery.

Large table *Acropora* (>3 metres across), Masjid Pura

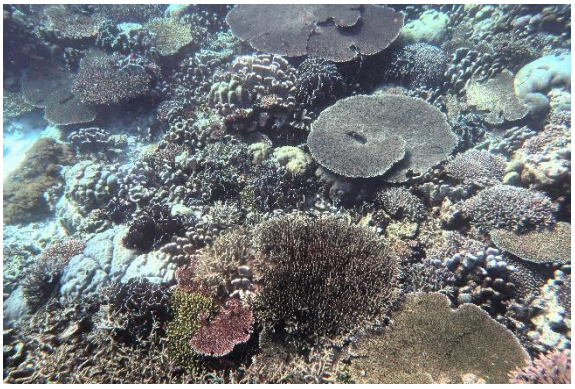
Maximum massive coral size

The massive coral species are more resistant to stresses of many kinds and are important in building the reef framework. Their presence and size tell us about the history of stress on a reef community as well as the prospects going forward: if the reef is dominated by massive and more stress resistant species it suggests that the community sustains levels of stress that the more susceptible species cannot tolerate; and it could also indicate that there is a change in the structure of a coral community to one composed of only the more resistant species. The presence of coral rubble that comprises broken pieces of branching and table corals would support this. A robust healthy community of resistant coral species still provides many of the functions of a more diverse community. The massive species provide substrate for other species to settle and an important barrier against coastal erosion.

Massive *Porites lobata* colony >200 years old, Manuseli

Broad size range

A broad size range of table corals is a useful indicator of regular coral reproduction and of successful recruitment of new corals to the population. The large old corals indicate a long history of surviving or avoiding stress and the intermediate and small sizes of younger colonies indicate maintained health of the system, including regular reproduction and strong larval settlement and growth. The broad size range also tells us that corals are reproducing regularly and settling out successfully in damaged areas, from which we can deduce that water and substrate conditions favour coral health, settlement, and growth. Thus, size range is an indicator of both stress resistance and recovery.



Size range of table *Acropora* corals, Manuseli

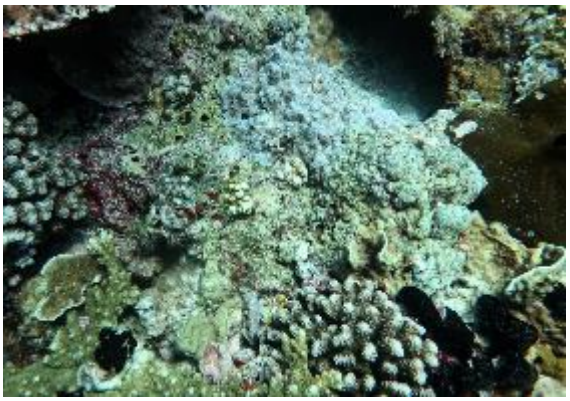
Range in size of *Acropora* table corals, Ipet

Stress recovery indicators

Recruitment

Strong coral recruitment measured by the number and variety of small, young corals is an indicator that the substrate and water quality are good, local conditions support the growth of corals, breeding colonies of different species survive nearby, or that there is effective connectivity with distant healthy resistant communities which provide larvae needed to repopulate damaged areas.

Strong hard coral recruitment on rock pavement (>10 recruits, >5 different genera), Serbete North



Strong coral recruitment (>10 recruits, >5 species), The Croc's Tail

Strong hard coral recruitment on dead coral head, Masjid Pura

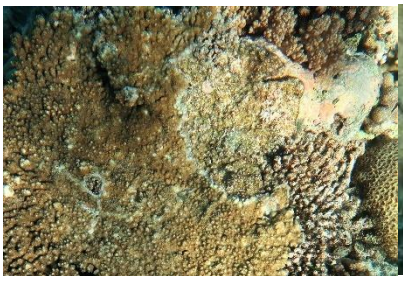
Strong hard coral recruitment on rock pavement (>10 recruits, >5 different genera), Serbete North

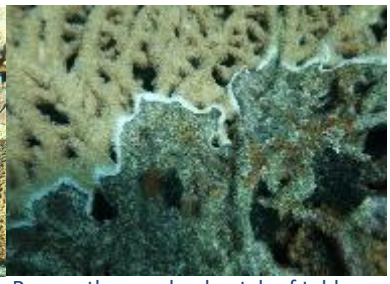
Lesion repair, regrowth and reorientation

Active lesion repair following fish predation or abrasion by coral rubble, regrowth over dead patches of a coral colony killed for example by starfish predation or sediment deposits, and reorientation in the plane of growth when corals are toppled or even completely overturned are good indicators of coral health and resilience. They show that local conditions favour coral health, nutrition, and growth.

Pale raised growing edge of corals repairing lesions: table *Acropora* (left) branching *Isopora* (right)

Lesion repair, regrowth, and damage repair can be recognized by the presence of a pale, actively growing margin to the live coral that is raised above the surface of the dead patch.





Lesion repair (left) and regrowth over dead patch of table *Acropora* (top right), Manuseli

Regrowth over dead patch of table *Acropora* coral colony), Waipukang

Corals exhibiting these responses are well-nourished, healthy, and have high energy reserves (fat deposits) to survive such shock and to help them invest in damage repair or changing their direction of growth. These same fat deposits can also help corals avoid starving to death during heat stress and bleaching events.

This table *Acropora* survived toppling, exhibits active growth, has good colour, and reorientated its growth forming new horizontal plates, Waipukang

Reversed direction of growth in overturned *Acropora* table, Kenaweh

Huge boulder *Porites* rolled down the reef slope, survived, and reversed its growth direction, Kenaweh

***Crustose coralline algae*:**

Crustose coralline algae coat dead corals and coral rubble in sometimes thick greyish pink layers. CCA cements loose coral rubble providing a consolidated substrate on which coral larvae can settle and grow. There is also evidence that the CCA puts out chemical signals which attract coral larvae to settle and inhibit algal settlement and growth, thereby helping coral reefs to recover from damage and continue to grow.

Strong hard coral recruitment on dead coral covered by crustose coralline algae, Manuseli

Dead *Acropora* table coral covered by crustose coralline algae offers a favourable substrate for coral recruitment, Marisa Channel

Stress indicators

Just as in humans, high stress levels compromise coral immunity and health. Indicators of compromised coral health include dead and sloughing coral tissue, gradual die back and inability to repair lesions, discolouration, diseases including growth anomalies (tumours), overgrowth by competitors for space, and infestation by burrowing organisms (molluscs, worms, barnacles, sea urchins) that weaken the coral skeleton. These are all markers of compromised coral health that affect their resilience to heat stress and global warming. Physical damage from storm surge, earthquakes that shake coral colonies off their pedestals, abrasion by sediment and rubble and deposition of these on corals, careless contact and breakage by divers, and plastic pollution are all additional causes of coral stress and die-back.

Disease

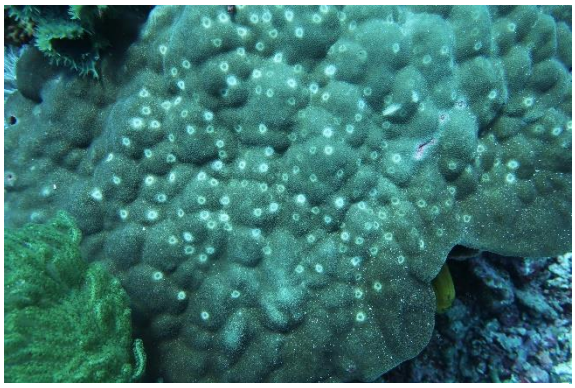
Large tumour on table *Acropora* coral, Pantar Ledge

Trematodiasis, Bacatan Ledge

Acropora white syndrome, The Croc's Tail

Acropora white syndrome, Marisa Channel

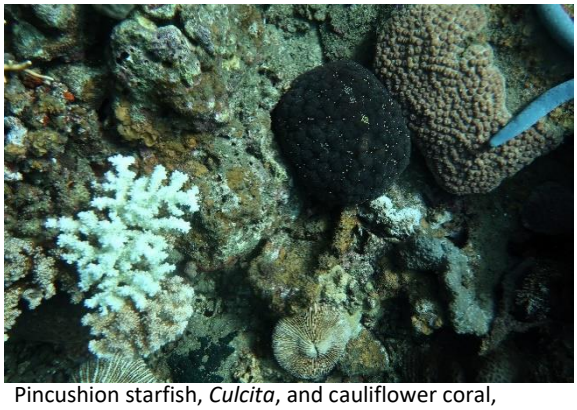
Ulcerative white spots on *Porites*, Marisa Channel



Ulcerative white spots on *Porites*, Ipet

Black band disease bordering bleached *Goniopora* coral polyps, Bacatan Wall

Predation



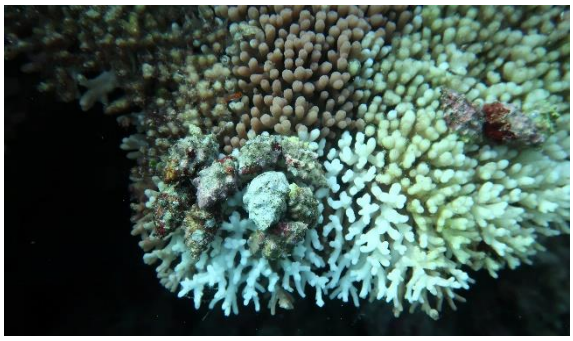
Pincushion starfish, *Culcita*, and cauliflower coral, Pocillopora, it has eaten, Waipukang

Pincushion starfish, *Culcita*, and *Stylophora* coral, it has eaten, Watupeni

Healthy corals can recover from such shallow fish bites that remove coral polyps but leave the skeleton Intact, Manuseli

Deep bites out of *Porites* boulder coral by bumphead parrotfish opens it to borer invasion, Pantar Ledge

Predatory *Coralliophila* snail on boulder *Porites*, a favoured coral, Pulau Babi North

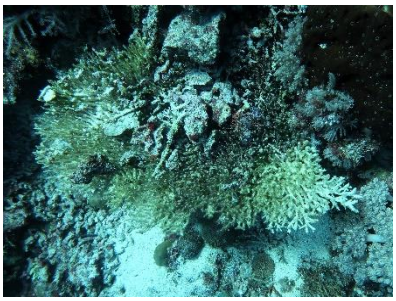


The predatory *Drupella* snail beside white newly eaten coral can have outbreaks of hundreds and kill off large coral colonies, Pulau Babi North (left), Anchor Bay (right)

Smothering and abrasion – coral rubble and sediment

Rubble washed off reef shelf caught by vase coral, *Turbinaria*, Anchor Bay

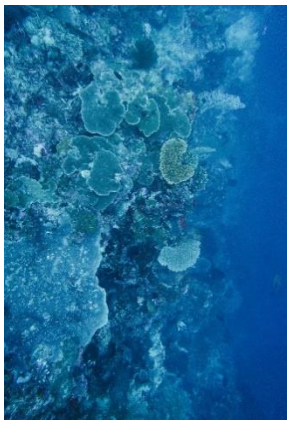
Cascading rubble on table *Acropora*, The Croc's Tail



Rubble cascading down wall killed this young table *Acropora*, Anchor Bay

Coral rubble cascading down the wall is trapped by and killing this young *Porites* coral, Pulau Babi South

Rubble-blasted boulder *Porites*, Manuseli



Sediment and shell fragments washed of the reef shelf distressing *Porites* (left), carpeting sponge (center), and impacting various corals down the wall (right), Sea Lady's Corner

Miscellaneous other indicators of coral stress

Competition: *Goniastrea* coral succumbs to aggressive sponge

Competition for space among hard corals can be fierce. The faster growing branching corals are overgrowing the table coral. This is part of the natural dynamics of a vigorously growing coral community, Dambila

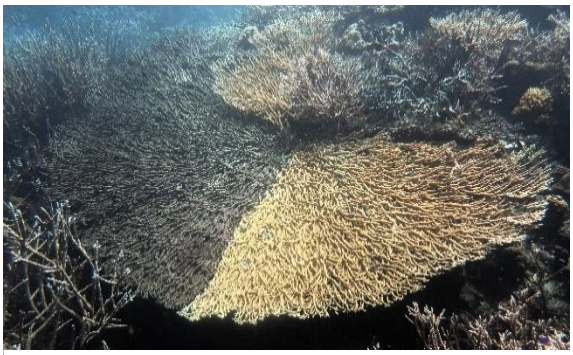
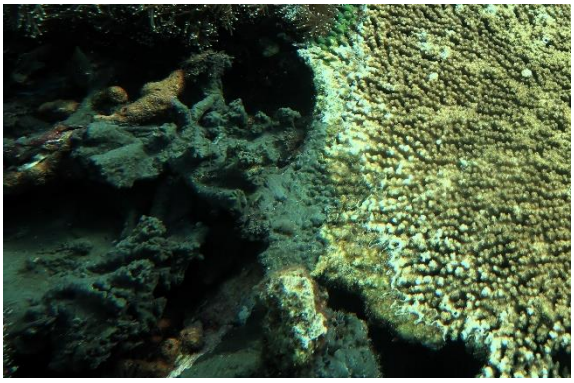
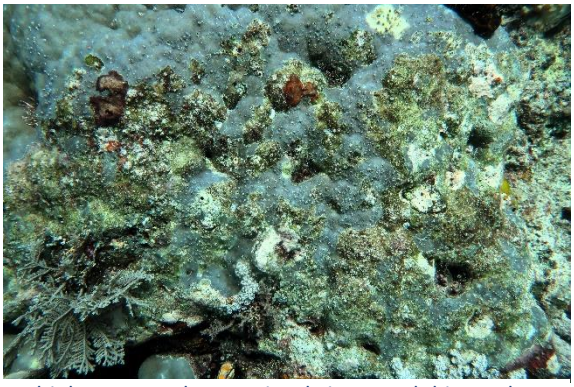


Table *Acropora* coral precisely divided into half alive and half dead likely caused by the coral killing cyanobacteriosponge *Terpios hoshinota*, Waipukang



Terpios hoshinota, overgrowing branching and table *Acropora*, Masjid Pura



Multiple stressors have seriously impacted this coral head, Bacatan Ledge

Impact of multiple stressors weakens this *Porites* coral head, Pulau Babi South

Dead hard coral colonies that succumbed to unknown stressor that likely include volcanic ash from nearby Lewotolok volcano, Waipukang

Fisheries

Smashed coral surrounds this fish trap, Pura Timur Laut

Smashed coral in blast-fishing crater, Pura Timur Laut

Site Descriptions

Dambila

12th May 2023 Time in: 1700 Snorkel

Coordinates: 8°28.977'S; 122°28.062'E

Snorkelled over scattered coral outcrops on sand in fading light. Nothing noteworthy observed or recorded.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were not assessed.

Dambila Dive

12th May 2023 Time in: 1700 Dive:

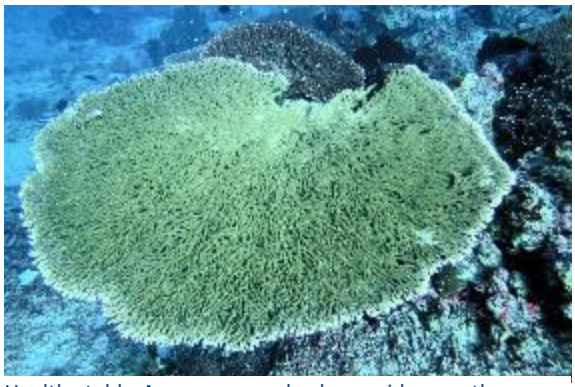
Coordinates: 8°29'5.40"S; 122°27'51.12"E

I did not dive at this site.

Kenaweh Wall, Adonara

13th May 2023 Time in: 0730 Dive: 17.0 metres; 61 minutes

Coordinates: 8°14'58.86"S; 123°19'34.32"E



Healthy table *Acropora*: good colour, wide growth margins, and no disease or predation

Reef slope with corals, rubble patches, and overturned table *Acropora* is a dynamic zone of periodic disturbance

Gentle drift dive in moderately strong current with an area of turbid, cold upwelling. The reef fell away down a moderate slope with sand and rubble pockets, silty rock outcrops, and patches of generally small live hard coral colonies. Cover of suitable substrate by hard corals averaged 30%, soft corals 13%, turf algae 33%, sponges 19%, crustose coralline algae 5%, and other cover <1%. Coral colour was good, reflecting low levels of heat stress at this time. Table corals reached between two and three metres across and had a full range of size classes represented. Massive coral colonies exceeded three metres in size.

Coral recruitment was strong, and corals were actively growing but their growth margins were narrow, and moderate for table *Acropora*. Values for coral lesion repair and overgrowth of dead portions of coral colonies were moderately low. There were many toppled corals indicating strong seismic activity in this area that shakes the coral colonies off their pedestals. One branching coral colony, one boulder *Porites* coral colony, and 28 table *Acropora* colonies had survived being toppled, including eight tables that were completely overturned and had reoriented their growth planes, and successfully adjusted to their new positions.

Sediment and rubble cascading down the slope were trapped by corals, damaging them. Coral disease levels were moderate and predation moderately high. Two pincushion starfishes were recorded.
Despite distress to corals from sediment, rubble and seismic activity, the stress resistance, recovery, and overall reef health and resilience potentials of this coral community were all high.


Table *Acropora* has survived toppling, reorientated its plane of growth, and formed new horizontal plates, a sign of good stress recovery potential

Ipet Reef and Wall

13th May 2023 Time in: 1100 Dive: 25.5 metres; 49 minutes
Coordinates: 8°14'30.66"S; 123°20'45.96"E

Drift dive in strong current over scattered coral outcrops with good health and colours, large sponges, and numerous sea fans. The slope was moderate to steep merging into a wall. Rubble slides and sandy patches were features of the slope. Cover of suitable substrate by hard corals averaged 48%, soft corals 22%, turf algae 10%, sponges 7%, crustose coralline algae 13%, and other cover <1%. Coral cover was good indicating low and tolerable levels of stress. Maximum table coral size exceeded three metres and they exhibited a full range of size classes. Massive corals reached more than two but less than three metres in size.
Coral recruitment was moderate. Coral colonies were actively growing and exhibited moderately wide growth margins. Both lesion repair and overgrowth of dead portions of the coral colony were observed on a total of 10 colonies each, which is a high value. Reorientation in growth plane of toppled colonies was observed in five colonies, a moderate value.
Debris falling down the slope and wall caused some distress to corals that trapped it. Coral disease levels were moderate and predation high.


Colourful coral bouquet


Imposing barrel sponge, *Xenospongia testudinaria*


Schooling Bannerfish *Heniochus diphreutes*

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high.

Watupeni (Ray's Rush Hour/Pulau Kroko)

13th May 2023 Time in: 1500 Snorkel

Coordinates: 8°14'23.29"S; 123°19'16.39"E

Supplemental notes from 06 May 2019

A wide sandy reef flat with coral patches and dense stands of strap seagrass, *Enhalus*, and other species separates the island from the fringing reef.

Cover of available substrate by hard corals averaged 64%, soft corals 11%, turf algae 17%, sponges <1%, crustose coralline algae 8%, and other cover <1%.

Coral colour was good for 90% of the colonies, 10% were exhibiting some paling, and 100% of *Seriatopora* and *Stylophora* colonies were paling. These two genera are heat stress susceptible corals and among the first to pale and bleach. This was similar to 06 May 2019 when 80% of coral colonies had good colour and 20% exhibited brightening colours and early paling (*Stylophora*, branching *Porites*, *Pocillopora*, *Seriatopora*).

Corals had active but narrow growth margins (moderate for table *Acropora*). Table *Acropora* corals reached between two and three metres in size (larger than recorded in 2019 when none was seen to exceed two metres across) and had a full size class representation. Massive corals did not exceed two metres in size.

Coral recruitment was moderate (strong in May 2019).

Lesion repair was recorded for two table corals, regrowth over dead portions of the coral colony for one table coral, and growth plane reorientation for four table corals that had been toppled over.

Tapestry of coral patches and seagrasses in shallows

Striped catfishes, *Plotosus lineatus*, circling boulder *Porites*

Blue damsels, *Pomacentrus pavo*, bejewel their *Acropora* coral sanctuary

Moderate levels of coral disease, including *Acropora* white syndrome disease on three colonies, tumours of one table *Acropora*, discoloration and ulcerative white spots on two different *Porites* colonies, and one case of trematodiasis were recorded. Coral predation levels were high, including high levels of coral infestation by burrowers and erosion of coral colonies by the long-spine sea urchin, *Diadema*. More than ten examples of coral predation by unknown organisms were recorded, and pincushion starfish *Culcita* feeding scars were seen; two large individuals were observed, one having fed on a small branching *Acropora* and the other on *Stylophora*.

This area was highly disturbed. There were broken and toppled corals and overturned dead table corals, and healthy coral colonies deeply eroded by sea urchins.

The stress resistance, recovery, and overall reef health and resilience potentials of this reef flat coral community appeared low.

False clown anemonefish, *Amphiprion ocellaris*

Starburst coral, *Galaxea*

Watupeni (Ray's Rush Hour, Pulau Kroko)

13th May 2023 Time in: 1500

Coordinates: 8°14'23.29"S; 123°19'16.39"E

Notes from Dive May 2019

Gentle rubble-sand slope with scattered live coral heads and coral patches among tangled sponges and large barrel sponges on sand-rubble substrate. Chutes with coarse sediment-covered rubble and large patches of branching coral rubble extended from the shelf down the slope. Live hard coral cover of available suitable substrate on the slope was about 10% but increased markedly on the shelf above four metres. Cover by sponges was 20%, turf algae 60%, and crustose coralline algae about 10%. Corals had good deep colouration indicating low stress levels at that time. *Seriatopora* colonies proved the exception and were pale or brightened in colour. Table *Acropora* corals reached between one and two meters in size (largest measured was 1.8 metres) and had a full range of size classes, which indicated regular reproduction and settlement of these corals and occasional widespread mortality. Live massive corals were smaller than two metres. Large (>3 metres) dead massive coral heads were settled and covered by hard coral colonies. Table and branching corals had moderate growth and foliose corals active but narrow margins. Coral recruitment was moderate. Lesion repair by corals was not observed and only one case of overgrowth of dead portions of one foliose coral colony was recorded. Growth plane reorientation was recorded for five table *Acropora* corals and one boulder *Porites* coral that had been toppled.

It is likely that storm-surges and monsoon wind generated waves wash over this shallow reef platform, break apart corals, and move the rubble over the reef top and down the leeward slope.

The levels of coral disease and predation were both moderate. Only one colony had *Acropora* white syndrome disease, and an additional six colonies exhibited multiple sources of stress. Coral predation

by two pincushion (*Culcita*) and one crown-of-thorns starfish was recorded. A further five colonies were infested with burrowing organisms. Two fishing lines were seen tangled in coral; and one fish trap seen on a rubble slope in about 12 metres depth. The extensive branching coral rubble and one smashed massive coral colony could have resulted from blast fishing, but no recent signs of this activity were detected. There was no direct evidence of recent heat stress and mass coral bleaching related mortality.

The low live hard coral cover and high sedimentation resulted in low stress resistance potential. Recovery potential was moderate. The overall resilience potential of this coral community appeared to be low.

Warawutun

14th May 2023 Time in: 0730 Dive: 15 metres; 62 minutes

Coordinates: 8°16'7.74"S; 123°32'58.62"E

Branching *Acropora* colonies

Very mild current, clear water over lava ridges below the volcano Gunung Api Lewotolok. The ridges were festooned with hard corals and clouds of fishes. Aquarium-like setting over black sand surrounded by rocky coral-covered ridges and fishes schooling in and over corals and up to the surface. There were extensive thickets of branching *Acropora* covering the rock ridges. Cover of available hard substrate by living hard corals averaged 44%, soft corals 17%, turf algae 23%, sponges 14%, crustose coralline algae 1%, and tunicates 1%. Coral colour was good with about 1% paling slightly. Table *Acropora* corals reached between two and three metres in size and had a full range of size classes. Massive coral species were all smaller than two metres. Coral recruitment was strong and table, branching, and foliose corals all had moderate to wide growth margins. Lesion repair was recorded for only two coral colonies, both branching, and only one toppled coral colony, a table *Acropora*, exhibited survival and reorientation of its growth plane.

Chuck beside large dead *Acropora* table coral possibly killed by ash deposits from Gunung Api Lewotolok

The level of coral disease was moderate with eight colonies exhibiting multiple signs of compromised health. One large *Diploastrea* colony had patches of dead coral. Coral predation was high. Two crown-of-thorns, one very small, and two pincushion starfishes were found, and seven coral colonies were riddled with burrowing organisms. The source of coral breakage could not be determined.

Five fishing lines and one line with an attached float were entangled in the coral.

The stress resistance potential was low, the stress recovery potential was moderately high, and the overall reef health and resilience potential was moderate for this coral community.

Volcanic ash and sediment among corals in gullies

Healthy benthic community on ridges where waves and currents likely prevent accumulation of volcanic ash

Waipukang 1&2

14th May 2023 Time in: 1100 Dive: 15.8 metres; 62 minutes

1500 14.7 metres; 58 minutes

Coordinates: 8°18'13.50"S; 123°31'49.38"E

Large table *Acropora* survived toppling and reorientated its growth plane to grow new horizontal plates in an expression of vigorous recovery potential

Entered over black sand beside coral covered rock ridges divided by silty-sand valleys below the volcano Gunung Api Lewotolok. Corals were a curious mix of heathy and unhealthy or dead hard corals. The second dive was in essentially the same location as the first. Seawater during the first dive was clear and calm. We experienced a mild current and more turbid water during the second dive. Live hard coral cover of suitable substrate averaged 38%, soft corals <1%, turf algae 26%, macroalgae (*Halimeda*) <1%, sponges 36%, crustose coralline algae cover <1%, and other organisms <1%. Coral colour was good, although 5% exhibited some paling. Both table *Acropora* and boulder *Porites* coral colonies exceeded three metres in size and the tables had a full range of size classes.

Coral recruitment was strong, and corals were actively growing with moderately wide growth margins. Two *Acropora* table coral colonies were the only examples with lesion repair. Overgrowth of damaged portions of the coral colony was recorded for four table *Acropora* colonies and two massive and two branching coral colonies. Dramatic examples of reorientation in growth plane of toppled corals were noted for four table *Acropora* colonies and one foliose coral.

Sediment covered many coral colonies and was trapped in depressions in the colonies causing localised mortality. There was one patch of heavily silted dead branching *Acropora*. Disease levels were high with one example each of *Acropora* white syndrome and tumours, also on a table *Acropora*, and 11 coral colonies exhibited multiple signs of compromised health. The level of predation was moderate. Twenty-four dead table *Acropora* larger than two metres were recorded. One *Diploastrea* colony had patches of dead coral. One large table *Acropora* was half live and half dead along a sharp line delineating the two halves. One pincushion starfish was observed beside a small cauliflower, *Pocillopora*, coral it had eaten.

There were five fishing lines, two ropes, one fish trap, and one gillnet entangled in the corals.

The stress resistance potential was moderate, but stress recovery and and overall reef health and resilience potentials of this coral community were high.

Demonstrating strong recovery potential, this table *Acropora* survived toppling and has grown new horizontal plates

Tubastraea tree coral, *Tubastraea micranthus*

Lamariang

14th May 2023 Time in: 1800

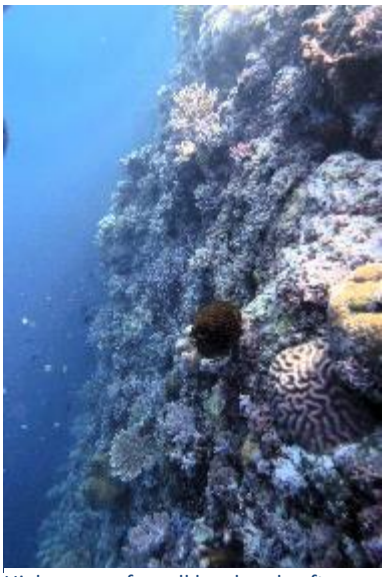
Coordinates: 8°17'54.10"S. 123°31'58.89"E

Night dive. I did not participate.

Bacatan Wall

15th May 2023 Time in: 0730 Dive: 11.6 metres; 61 minutes

Coordinates: 8°13'41.28"S; 123°36'13.14"E



High cover of small hard and soft corals down wall

Upper wall and shelf dive with changeable currents. Hard coral colonies on the steep slope and wall were small.

Live hard coral cover of suitable substrate averaged 24%, soft coral 23%, turf algae 37%, sponge 2%, crustose coralline algae 14%, gorgonians 1%. Coral colour was good with <1% white or near white and 4% paling. Neither table *Acropora* nor massive coral species exceeded two metres in size and the former had only a moderate distribution of size classes. Coral recruitment was high with corals showing narrow to moderately wide growth margins. No lesion repair, overgrowth of dead portions of the coral colony, or reorientation in growth plane of toppled corals were observed.

Levels of disease were moderate and predation high, with the greatest contribution to disease by multiple stressors causing compromised health and to predation by burrower infestations. One 25-centimetre *Goniopora* colony was bleached stark white and infected with black band disease along the margin where it had died. One pincushion starfish was observed beside a small cauliflower coral, *Pocillopora*, it had eaten.

Outer shelf reefscape with abundant soft corals and scattered small hard corals

Shelf break, upper slope hard and soft coral assemblage

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were low.

Bacatan Ledge/Shark Point

15th May 2023 Time in: 1100 Dive: 29 metres; 59 minutes

Coordinates: 8°13'14.52"S; 123°36'6.48"E

School of inquisitive rainbow runners, *Elagatis bipinnulata*

A wide five-metre-deep shelf leads onto a steep slope and wall. The current was strong along the wall and over the ledge. Corals over the ledge and upper slope were low and robust. A huge patch of coral rubble was solidly cemented in place by crustose coralline algae and there was a large area of the stout branching catch bowl coral, *Isopora palifera*. Cover of suitable substrate for hard

Robust, low profile hard corals characterise the wave and current swept outer shelf and upper slope

corals averaged 22%, soft coral 28%, turf algae 18%, sponges 7%, crustose coralline algae 25%, and other organisms <1%.

Sea fans were prolific along parts of the upper slope

Coral colour was good and growth margins active. Maximum size of table and massive corals was around one metre, and the former had an incomplete range in size classes. One very large boulder *Porites* colony was 80% dead. Coral recruitment was moderate. Only one example each of lesion repair, overgrowth of dead portions of the coral colony, and growth plane reorientation of toppled corals was recorded.

A school of nine large rainbow runners, *Elagatis bipinnulata*, circled around observing our labours.

Levels of disease were moderate and predation high. Among other signs of predation, three crown-of thorns and three pincushion starfishes were seen feeding on or beside corals they had eaten.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were low.

Cardinal/Nera Jetty

15th May 2023 Time in: 1500 Snorkel

Coordinates: 8°17'41.31"S; 123°36'19.74"E

Supplemented by notes from 09 May 2019

Calm with very weak and barely perceptible current. Entered over reef crest with shallow *Tubastraea* tree corals (black sun corals), *Tubastraea micranthus*, crowded with cardinal fishes. A wide reef flat extended landwards to a border of dense seagrass and seawards to the reef crest and steep slope leading onto sand.

Golfball sponge, *Cinachyra* sp.

Barrel sponge, *Xestospongia testudinaria*

The reef crest and slope were dominated by large patches of branching yellow finger coral, *Porites cylindrica*, or whorls of foliose *Echinopora*. As is typical with actively growing *P*. *cylindrica* at the reef crest, this was breaking away in big sections and settling on the upper slope or rolling down it.

The reef flat had smaller colonies of *P*. *cylindrica*, *P*. *nigrescens*, and boulder *Porites* species, bushy and branching *Acropora*, *Pavona*, *Seriatopora*, faviids (honeycomb corals), yellow foliose *Turbinaria*, other hard corals, soft corals, and the strap like seagrass *Enhalus*.

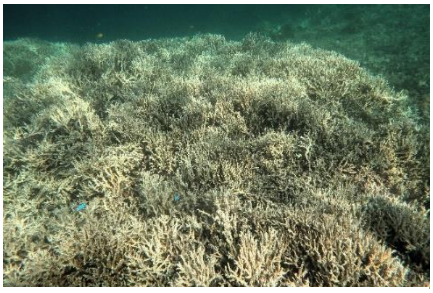
Coral cover on the outer reef flat and crest varied between 60% and 80% and averaged 67%. Soft corals averaged 3%, turf algae 8%, sponges 3%, and crustose coralline algae 18%. Coral colour was deep and good over the reef slope and generally, but there was some very early brightening of *Seriatopora* and *Stylophora* corals on the reef flat and one large colony of *Anomastrea* was very pale. Both table *Acropora* and massive corals reached 1-2 metres in size and the table corals had a moderate range in size classes. Coral recruitment was strong, and corals were actively growing with narrow to moderate growth margins. Overgrowth of dead portions of the coral colony was observed in one massive coral and reorientation of growth plane observed in three table *Acropora*, one foliose species, and three massive corals, and >10 branching *Porites* colonies that had been toppled.

One pincushion starfish was recorded beside a freshly eaten *Seriatopora* coral colony. Two large old chameleon eye corals, *Diploastrea*, colonies that were >80% dead with small patches of live tissue were

Blunt finger coral *Porites cylindrica*

Lettuce coral, *Echinopora lamellosa*

Yellow, scroll coral, *Turbinaria reniformis*



Pale colony of briar coral, *Anacropora* sp.

Characteristic reef crest assemblage of finger and lettuce corals

Strap seagrass, E*nhalus aceroides*

seen. It is possible that this was evidence of previous predation by the crown-of-thorns starfish which I have recorded eating *Diploastrea* off West Timor.

Two massive *Porites* and *Goniastrea* colonies were deeply eroded, evidently by sea urchins grazing down turf algae. Five *Porites* colonies were heavily infested with borers, and two suffered tissue loss. The high incidence of borer infestation, bioerosion suggested that massive corals, particularly *Porites*, suffer some distress.

A great quantity of litter below the pier

One banded sea krait, a pair of egg cowries, and a group of five knife fishes were seen. Seagrass beds functioned as nursery for juvenile cardinalfishes.

The stress resistance potential was low, and the recovery and overall reef health and resilience potentials of this coral community were moderate.

Marisa Channel

16th May 2023 Time in: 0730 Dive: 16.4 metres; 63 minutes

Coordinates: 8°23'31.94"S; 123°56'26.57"E

Solid table *Acropora* coral with active blue growth margin

Entered over a sand and rubble slope with scattered small coral colonies. A strong current with some mixing upwards of colder water (temperature range 26-28C) carried us north along the reef to an area of lush coral growth with deep-coloured corals and banks of branching and large table *Acropora* colonies, and massive coral species, notably boulder *Porites* and *Galaxea*. The highest cover of hard corals was between four and 17 metres depth. Cover of suitable substrate by live hard corals averaged 42%, soft corals 24%, turf algae 15%, sponges 1%, crustose coralline algae 18%, other organisms <1%. Corals had deep, good colouration. Both table *Acropora* and boulder corals exceeded three metres in size and the former had a full range of size classes. The largest table *Acropora* measured 6.3 metres across.

Coral recruitment was strong, and the colonies were actively growing with narrow growth margins,

Lush growth of predominantly branching and table *Acropora* species down the slope. Corals have good, deep colour, and active growth margins.

moderate for table *Acropora*. Three coral colonies were repairing lesions, two regrowing over dead portions, and three, all table *Acropora*, had survived being toppled off their pedestals and had reorientated their plane of growth. The soft coral *Xenia* dominated patches, generally where large *Galaxea* colonies were found.

Starburst coral, *Galaxea*, colony soars 2.5 metres above the reef

The levels of coral disease and predation were both high. Five table corals were infected with *Acropora* white syndrome disease.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high.

Tanjung Nahu

16th May 2023 Time in: 1100 Dive: 19.9 metres; 50 minutes

Coordinates: 8°17'36.15"S; 124° 3'41.48"E

Steep rock slope with sand-rubble patches, scattered hard and soft corals, and shallow sandy gullies. A current was ripping along the reef and changing direction. The shelf had large sandy and rubble patches and scattered rock outcrops covered by live hard corals. Larger boulder *Porites* corals and patches of foliose *Turbinaria* coral were found along the reef crest. Overall hard coral cover of suitable substrate averaged 18%, soft coral 28%, turf algae 13%, sponges 35% crustose coralline algae 7%, and other organisms <1%. Coral colour was deep and good. Table corals barely exceeded one metre in size and had a moderate range of size classes. Massive corals exceeded three metres in size. Coral recruitment was moderate. All this suggests that this coral community suffers occasional stress events that take out the stress susceptible table *Acropora* and related species but does not affect the more stress tolerant massive corals. Corals were actively growing but growth margins were narrow.

No examples of lesion repair, overgrowth of dead portions of the coral colony, or reorientation in growth planes of toppled corals were noted.

The levels of coral disease and predation were both high. Eleven coral colonies demonstrated multiple causes of compromised health and nine colonies were infested with burrowing organisms.

Several blacktip reef sharks were seen.

The stress resistance potential of this coral community was moderate, and the recovery and overall reef health and resilience potentials were low.

Thriving scroll coral, *Turbinaria,* at shelf break above wall

Blacktip reef shark over rubble-sand patch on upper slope

Table *Acropora* and other corals actively colonise small rocky outcrops on the sand flats. But their small size indicates periodic turnover of these corals.

Manuseli 1&2

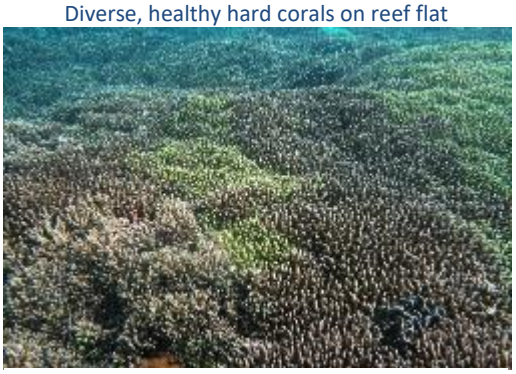
16th May 2023 Time in: 0730 Snorkel

19th May 2023 Time in: 1500 I didn't dive/snorkel

Coordinates: 8°10'22.92"S; 124°18'55.98"E

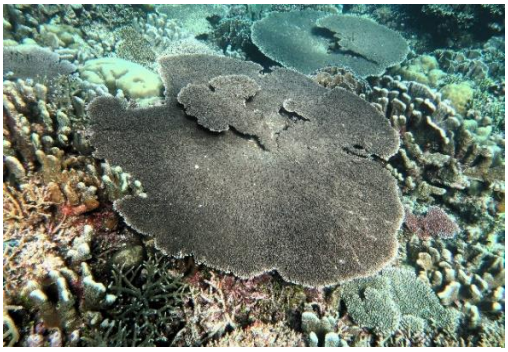
Diverse, healthy hard corals on reef flat

Most of the time spent over the shelf. The current was strong. This was a current and wave scoured area with bare rock and scattered large and small live hard coral colonies. Several massive coral colonies were toppled and table *Acropora* overturned. Hard coral cover averaged 57%, soft coral 3% and noticeably sparse, turf algae 22%, sponges 1%, crustose coralline algae 17%, other organisms <1%. Corals were deeply coloured, and both table *Acropora* and massive corals reached over two metres in size. The table corals had a full range of size classes. Coral cover was very high in places and constituted mainly of branching and table *Acropora* species, *Isopora* and various small, massive coral colonies. There were large banks of tightly branched *Acropora* in two colours, green and brown, where live coral cover approached 100% over at least 1,500 square metres. Coral colour was dark and healthy, and corals were actively growing with moderately wide growth margins. Both table and massive coral colonies reached over two metres in size, and the former had a full range of size classes.



Ridge carpeted by close-branched *Acropora* coral. These corals appear healthy, but such monospecific stands are susceptible to outbreaks of disease and corallivores, such as the crown-of-thorns starfish

Coral recruitment was high. Examples of coral lesion repair and overgrowth of dead portions of the colony were moderate, and reorientation of toppled colonies was high, including eight table *Acropora* and two boulder *Porites*.



Healthy table *Acropora* coral: deep colour, wide growth margin, large size, and no disease

Tumbled and overturned corals and rocks

Both disease and predation levels were high with 15 colonies showing multiple signs of compromised health.

Despite the damage by waves and currents to this coral community, the stress resistance, recovery, and overall reef health and resilience potentials were high.

Muka Kampung

17th May 2023 Time in: 0730

Coordinates: 8°16'30.42"S; 124°21'1.32"E

I have no notes or photos for this site; took a rest day to dope up and favour injured rib.

Bakalan Jetty

17th May 2023 Time in: 1100

Coordinates: 8°16'3.29"S; 124°17'58.29"E

I have no notes or photos for this site; took a rest day to dope up and favour injured rib.

Board Room

17th May 2023 Time in: 1500

Coordinates: 8°17'10.24"S; 124°19'27.29"E

I have no notes or photos for this site; took a rest day to dope up and favour injured rib.

Alami Alor reef

17th May 2023 Time in: 1830

Coordinates: 8°16'19.34"S. 124°26'41.13"E

I have no notes or photos for this site; took a rest day to dope up and favour injured rib.

Pantar Ledge 1&2

18th May 2023 Time in: 0730 Dive: 15.4 metres; 62 minutes

20th May 2023 Time in: 1100 Dive: 16.4 metres; 61 minutes

Coordinates: 8°17'31.08"S; 124°18'17.88"E

Wide growth margin indicates vigorous growth of this table *Acropora* coral

Healthy table *Acropora*: large size, wide growth margin, good colour, no disease

Gentle dive over steep slope and beside wall ending in <5 metres over shelf with high cover of hard and soft corals and sponges. Current gradually increased and drifted with it over upper slope. The current was ripping along the reef for the second dive (20th May) with up and down currents and reversal. Flew along reef in one direction and returned with reversal. Escaped worst current by moving to shallows. The bright green, encrusting didemnid ascidian, *Diplosoma virens*, was conspicuous on the second dive. Chuck Birkeland, who published a paper on this colonial tunicate in

1981 confirmed the identification, and included the interesting observation that scientific naturalists were aware of colonial tunicate motility since the mid 1800s. Its never too late to learn.

Live hard coral cover averaged 28%, soft coral 28% and reached 60% over parts of the shelf, turf algae cover 18%, macroalgae (*Halimeda*) 5%, sponges 15% and reached 50% on the wall, crustose coralline algae 5%, and hydroids 1%.

Tubastraea cup and tree corals covered as much as 25% of the wall in places. Colourful soft corals formed impressive hanging gardens mixed with sponges and bright green *Tubastraea* tree corals under the overhangs on the wall. And clouds of orange *Anthias* swept up and down along the wall.

Corals had deep, healthy colouration. Table *Acropora* and massive corals both exceeded two metres, but less than three metres, in size and the former had a full range of size classes.

Coral recruitment was moderate. Coral lesion repair was low and no cases of overgrowth of dead portions of the coral colony were observed. Only three coral colonies that had been toppled demonstrated growth plane reorientation.

Levels of coral disease were low and predation high including large bites out of *Porites* boulder coral by the bumphead parrotfish *Bolbometopon*.

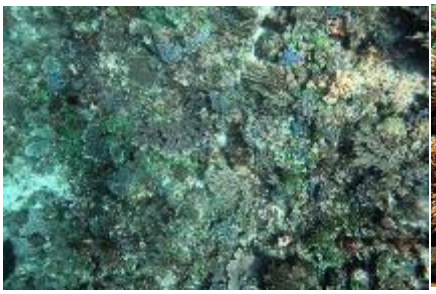
One fish trap weighted with rock and coral boulders was secured to the reef.

Encrusting didemnid ascidian, *Diplosoma virens*,

Brightly coloured soft corals and sponges under overhang on wall

Plating corals down the wall

Upper reef slope benthic community



Lower reef slope benthic community

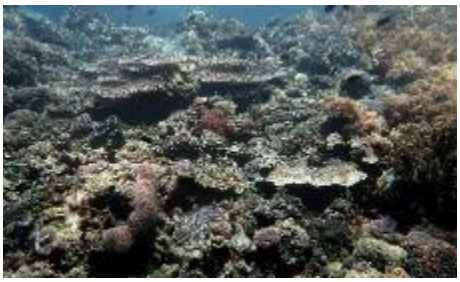
Benthic community in sheltered pool,

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high.

Pura Timur Laut (NE)

18th May 2023 Time in: 1100 Dive: 17.8 metres; 59 minutes

Coordinates: 8°16'42.60"S. 124°21'37.26"E



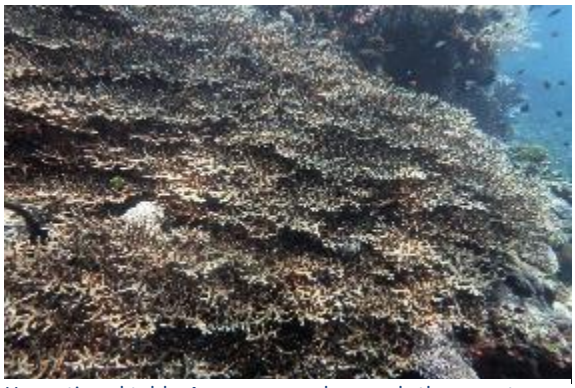
Hard coral covered shelf

High hard coral cover lower slope

Entered over large patch of 100% cover by live healthy hard foliose *Echinopora lamellosa* coral mixed with 1-1.5 metre branching *Acropora* colonies. Drifted slowly with current along the coral-covered slope to the shelf and stayed above six metres. The slope was covered by a mixed coral assemblage, conspicuous elements of which were *Lobophyllia*, branching *Acropora*, *Stylophora*, *Seriatopora*, *Euphyllia*, and numerous fungiids.

Live hard coral cover averaged 50%, soft coral 2%, turf algae 27%, sponges 17%, crustose coralline algae 3%, and other organisms <10%. Coral colour was deep and healthy. Table *Acropora* reached over three metres in size and had a full range of size classes. Massive corals reached over two but less than three metres. Coral recruitment was strong, and the corals were actively growing with narrow or moderate (table corals) growth margins. Coral lesion repair was moderate and both overgrowth of damaged portions of the colony and growth plane reorientation in toppled corals were moderately high.

The level of hard coral disease was moderate and of predation was high. Two crown-of-thorns and four pincushion starfishes were recorded, and their feeding scars were conspicuous suggesting many more of the former.



Huge, tiered table *Acropora* coral exceeds three metres

Numerous fish traps weighted with rocks and placed directed on corals caused extensive coral breakage. At least two blast fishing craters were noted. Damage resembling that from anchors and mooring ropes was common on the slope, and there were large dead massive corals and a large field of rubble extending down the slope.

The stress resistance potential of this coral community was moderate, and both the recovery and overall reef health and resilience potentials were high despite the degree of fishery damage.

Matap

18th May 2023 Time in: 1500 Dive: 16.8 metres; 62 minutes

Coordinates: 8°17'26.76"S; 124°24'52.08"E

Group of squid demarcate the thermocline

Mild current over slope with small patches of high live hard coral cover or high soft coral cover. There were also patches of dead hard corals densely covered by algal turf and large areas of tumbled rocks and rubble. The slope was generally mucky but large rock outcrops provided oases of life. These were densely covered by corals, sponges and crinoids and attracted fish life. Corals included 1-2 metre table *Acropora* with deep healthy colouration, active growth margins and no lesions. Cover varied from 40% live hard coral to 60% macroalgae to 40% soft coral with the remainder filled in by a mix of sponges, turf algae and hydroids surrounded by vast patches of coarse sand with shell fragments and rubble.

Sand- rubble slope with soft coral covered tumbled rocks

On average cover of suitable substrate of rock outcrops was 18% for hard corals, 28% for soft corals, 12% for turf algae cover, 20% for different macroalgae, 16% for sponges, 3% for crustose coralline algae, <1% for zoanthids (*Palythoa*), and 2% for hydroids. Coral colour was good, Table *Acropora*

Coral rubble cemented by crustose coralline algae and settled by sponges and the weedy hard coral *Seriatopora*

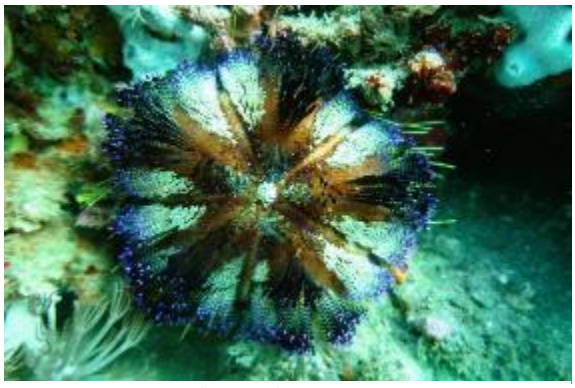
Sponge dominated benthic community on rock outcrop

Hard coral community on rocky ridge

colonies reached over two metres, but less than three metres in size and had a full range of size classes. Massive coral colonies reached over three metres in size. However, both the table and massive corals were uncommon. Coral recruitment was high, but survival evidently poor beyond 30 centimetres in size. Coral growth margins were narrow to moderate for table *Acropora* only.

Only one colony exhibited lesion repair, none had overgrowth of damaged areas, and one table *Acropora* survived being toppled to change its growth plane.

Levels of disease are moderate and predation high.
A large group of squid hovered along the thermocline, and we watched each other for some time until, spooked by something, they jetted away in a flash and disappeared.
Fire urchins, *Asthenosoma varium*, were seen here.
This is a marginal hard coral community.


Fire urchin, *Asthenosoma varium*

Despite focussing on the best substrates for coral settlement and growth, the stress resistance, recovery, and overall reef health and resilience potentials of this coral community were low.

Mucky Mosque
18th May 2023 Time in: 1830
Coordinates: 8°16'9.46"S; 124°25'17.82"E
Night dive. I did not participate.

Manuseli
19th May 2023 (combined with 16th May dive – see earlier)

The Croc's Tail, Pulau Buaya

19th May 2023 Time in: 1100 Dive: 16.4 metres; 61 minutes

Coordinates: 8°10'5.64"S; 124°22'29.70"E

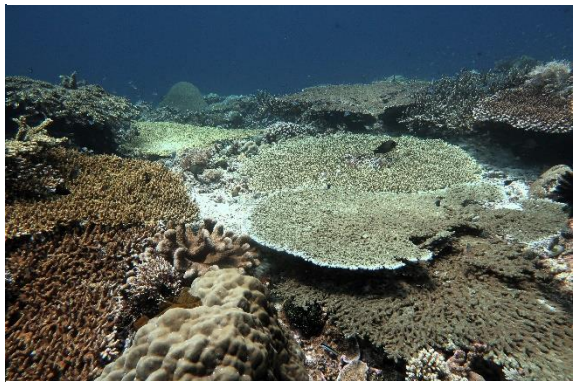
Kept above seven metres for most of the dive where coral growth was better developed.

A shelf led out to nine metres where the slope became steeper and progressed down to a wall. Coral cover was highest above nine metres. Parts of the slope had little more than sand and coral rubble with a few scattered coral colonies impacted by debris moving down the slope. Exposed rock surfaces were

Scattered hard and soft corals on reef shelf

Large boulder *Porites* colonies 2-2.5 metres high (200-250 years old) are found on the shelf

Large slope area overwhelmed by sediment and rubble

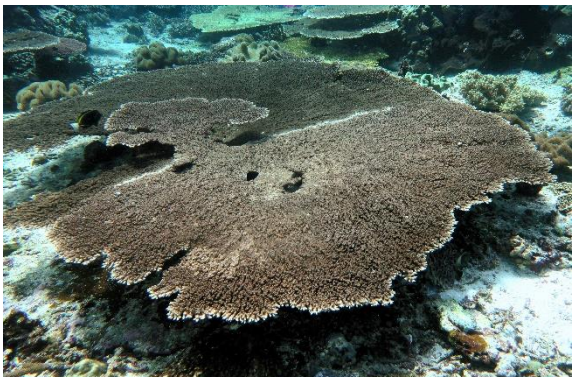


Healthy corals, good colour, active growth, on outer shelf

scoured clean with a light cover of turf algae. Above seven metres, hard coral cover averaged 40%, soft coral 18%, turf algae short (<1 millimetre) 21%, sponges <1%, crustose coralline algae 21%, other organisms <1%. Coral colour was good. Both table and massive corals reached or exceeded two metres in size and the former had a full range of size classes.

Coral recruitment was high. Corals were actively growing with narrow growth margins for branching and foliose corals and moderately wide margins for table *Acropora*. Lesion repair and reorientation of the growth plane of toppled corals were high. Overgrowth of damaged portions of coral colonies was moderate.

The level of disease was moderate, and predation was high. Six large dead table *Acropora* were noted. In one part of the shelf there were scattered *Porites* boulders on sand and small rocky outcrops.


Large, deep coloured table *Acropora* with active, wide growth margins is a paragon of health


"Oases in the sand," coral bommies covered by active growth of healthy corals

Forming oases of life on the white sand shelf, the rocks housed a variety of vigorously growing corals, including large tables, and clouds of coral fishes.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high.

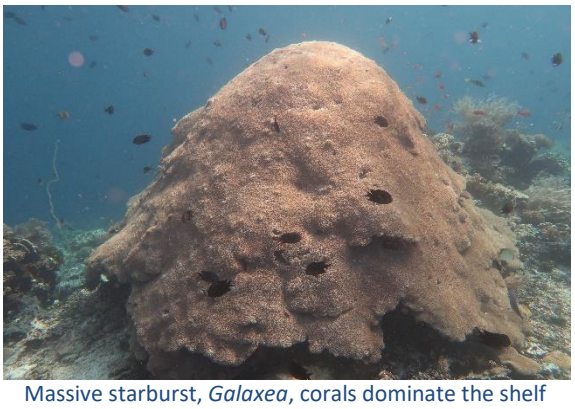
Babylon

19th May 2023 Time in: 1500 Dive: 7.3 metres; 59 minutes

Coordinates: 8°13'22.68"S; 124°21'47.34"E


Anthias swarm over the shelf break above the wall

Elected to dive over the shelf where corals were better developed than down the wall. Consequently, most of the dive was shallower than five metres. Between three and five metres, hard coral cover averaged 33%, soft corals 30%, turf algae 22%, macroalgae (*Halimeda*) 7%, sponges 5%, crustose coralline algae cover 3%, and tunicates and other organisms <1%. However, particularly distressing was the heavy outbreak of *Terpios hoshinota* sponge that was overgrowing and killing many corals and dramatically changing benthic cover percentages. This is an aggressive coral killing cyanobacteriosponge that can have massive outbreaks and is expanding its range across the Indo-Pacific. This was a major change from previous visits to this site (2011, 2014, 2017, 2018, 2019) and something of concern.


Massive starburst, *Galaxea*, corals dominate the shelf

Otherwise, coral colour was good, table *Acropora* exceeded two metres in size and had a full range of size classes. Massive corals, *Galaxea* principally, exceeded three metres in size. Coral recruitment was high. Corals were actively growing with narrow growth margins for branching and foliose corals and moderately wide margins for table *Acropora*. No lesion repair or overgrowth of damaged portions of

coral colonies were recorded, and only five coral colonies that had been toppled survived to reorient their planes of growth.
The level of coral disease was low, and predation was high.
The stress resistance potential was high, and the recovery and overall reef health and resilience potentials of this coral community were moderate.

Beangabang wall
20th May 2023 Time in: 0730
Coordinates: 8°29'31.14"S; 124°10'28.74"E

I did not participate in this dive but include my notes from 18th August 2014 (Dive: 15 metres; 53 minutes). Seawater temperature was 23-24C.
On the bay side there was a steep slope 50% covered by hard and soft corals, sponges, and algae (especially *Dictyota*) that led onto rocky promontories supporting a variety of foliose and massive hard corals (notably *Pachyseris*, *Echinopora*, *Pectinia*, Turbinaria; *Porites*, *Diploastrea*, *Platygyra*, other faviids, *Goniopora*, *Astreopora*) and soft corals (large *Sarcophyton*, *Sinularia*), invertebrates of many types, and eight egg cowries (*Ovula ovum*) in soft corals.
Corals all had good colour and no signs of disease, although there were several long-dead table *Acropora*. These dead tables had no recruits, but recruitment onto rock surfaces was strong.
The resistance potential was moderately high, recruitment high depending on substrate, and the overall resilience potential for this coral community was moderately high.

Pantar Ledge 2
20th May 2023
Combined with notes for 18th May 2023. This dive coincided with the onset of inflammation of Chuck's leg. It is worth thinking more about this. The zoanthid, *Palythoa*, was more common here than at other dives sites. Although we did not identify the species, it does resemble the highly toxic *Palythoa toxica*. It is possible Chuck suffered a severe toxic reaction because:

1) Chuck held onto the substrate because of the strong up and down current thereby potentially exposing any open wound directly to the *Palythoa* mucus;
2) Chuck cut his leg mounting the ladder into the tender potentially exposing the cut to mucus;
3) Chuck felt especially poorly the night of the 20th and was clearly reacting to something;
4) That night and the following day his leg reacted, swelling very fast;
5) Chuck showed no response to the topical or oral antibiotics administered on aboard nor to the intravenous antibiotic administered in the Maumere hospital:
6) No pathogen was isolated by Queens Hospital in Honolulu where Chuck was treated for three days.

These are speculations but another good reason to be especially careful not to contact the reef during our diving. Chuck and I have discussed this possibility and my thoughts are added here at his suggestion.

Masjid Pura

20th May 2023 Time in: 1500 Dive: 17.8 metres; 59 minutes

Coordinates: 8°16'29.56"S; 124°20'32.49"E

Large boulder *Porites* in the shallows flattened by exposure at low tides forms classic micro atoll.

Swam vigorously with current and covered considerable distance moving into coral rich shallows for last 20 minutes. Reversed direction with change in current. Mostly warm but cold-water upwelling toward the end of the dive. Hard coral cover of suitable substrate averaged 51%, soft corals 8%, turf algae 16%, macroalgae 1%, sponges 14%, crustose coralline algae 10%, and other organisms <1%. Coral colour was deep and healthy. Table corals exceeded three metres in size and had a full range of size classes. Massive corals reached close to three metres and boulder *Porites* grew in the shallows forming flat-topped microatolls.

Massive boulder *Porites* towers 2.5 metres above the reef

Coral recruitment was strong, and corals were actively growing with narrow growth margins except for table *Acropora* that had wide margins. Coral lesion repair was moderately strong, regrowth over dead portions of the colony was moderate and re orientation of corals toppled off their pedestals or completely overturned was exceedingly strong with 16 table *Acropora* colonies exhibiting this.

Euphyllia coral with tentacles protracted dominates the reef slope

Hard and soft coral and hydroid dominated reef slope

Coral disease and predation levels were moderate. Though the coral predators were not identified in six cases, the corals exhibited signs of both *Drupella* snail and crown-of-thorns starfish predation, but neither of these was seen. Early outbreaks of the coral killing sponge *Terpios hoshinota* were noted.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high influenced strongly by the well-developed coral community toward the end of the dive.

Large table *Acropora* corals are a feature of this coral community

Bacatan Ledge

21st May 2023 Time in: 0730 Dive: 28.4 metres; 60 minutes

Coordinates: 8°13'14.52"S; 123°36'6.48"E

Easy current along wall and over ledge. Drifted along without slate so looked into the blue for big fishes. Saw only two blacktip sharks, rainbow runners, and large bohar snappers down deep. Ended dive over ridges of *Isopora*.

See writeup for this site on the 15th May 2023 above.

Whitemouth moray, *Gymnothorax meleagris*

Nera Bakau

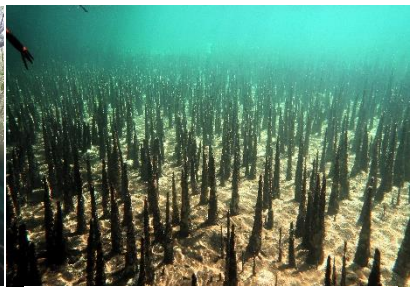
21st May 2023 Time in: 1100 Snorkel

Coordinates: 8°17'9.98"S; 123°34'29.83"E

Snorkelled among the mangroves. Saw unusually few archer fishes, at least two small blacktip reef sharks, mullet, few cardinalfishes, sardines, and small snappers among the mangroves. Surprisingly, and unlike previous visits to this site, no collector urchins were observed, although others saw many large urchin tests.

Tangled red mangrove prop roots, *Rhizophora mucronata*

Red mangroves, above and below water



Apple mangrove, *Sonneratia alba*, mangrove aerial roots

Tanjung Munu/Mulu Seamount

21st May 2023 Time in: 1500 Dive: 27.3 metres; 60 minutes

Coordinates: 8°15'35.86"S; 123°26'17.09"E

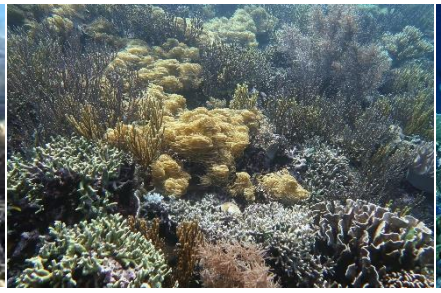
Large sea pen, *Pteroeides* sp.

Entered in blue water beside seamount. Mild current and the water was clear, calm, warm, and wonderful. The slope was covered by scattered small hard and soft coral colonies and small sandy patches. The reef was cut by a wide sand and rubble slide. Corals were better developed and cover higher on the ridges and promontories that fell sheer to over 25 metres. Shallower than four metres was a bank of close-branched *Acropora* corals that led into and was bordered by an octocoral dominated community constituted primarily of gorgonians and soft corals.

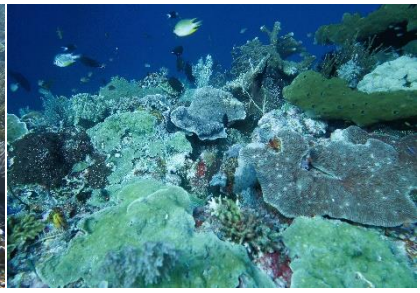
Descended to 27 metres down shear sided promontory where corals thrived, and fishes collected in frenzied schools (large emperors, giant trevallies, sweetlips, and large schools midnight snappers). At 27 metres a huge nurse shark was tucked into a cave. Ended over the shelf on a coral rubble field that had been firmly consolidated by crustose coralline algae.

Hard coral cover of suitable substrate averaged 22%, octocorals 36%, turf algae 19%, sponges 9%, crustose coralline algae 13%, and other organisms <1%. Coral colour was good. Table corals reached larger than two metres and had a full range of size classes. Massive corals were smaller than two metres.

Whorled cabbage coral, *Montipora*, dominates the ridge



Octocoral community dominated shelf



Hard corals and sponges dominate the outer shelf above the wall

Coral recruitment was strong, and corals were actively growing with narrow growth margins to moderately wide for table *Acropora* colonies. There were few examples of lesion repair (x2), overgrowth of dead portions of the coral colony (x1), and reorientation of growth planes for toppled colonies (x1). Levels of coral disease were moderate and of predation were high.

Large nurse shark, *Nebrius ferrugineus*, tucked into a cave

The deeper shelf leading up to the shallows had numerous large dead massive, branching and table corals and rubble fields consolidated by crustose coralline algae.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were moderate.

Rhinopias Bay

21st May 2023 Time in: 1830

Night dive. I did not participate.

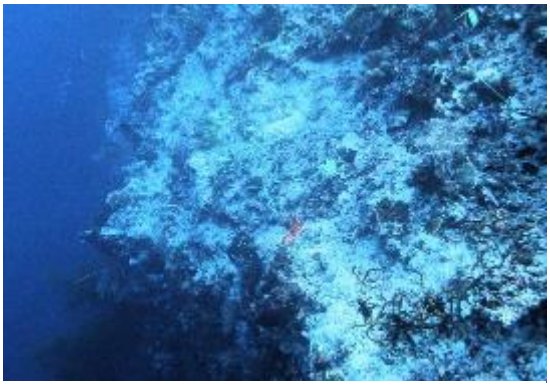
Serbete Wall North

22nd May 2023 Time in: 0730 26.3 metres; 61 minutes

Coordinates: 8° 8'48.60"S; 123° 0'25.74"E

Foued, ever vigilant, along the wall

A weak current carried us along the wall and over the shelf toward the end of the dive. Water 29C and very clear. The wall had sand pockets and small, scattered hard and soft coral colonies, black corals, sea fans, sponges, and sea whips. There were stepped ledges and caves from 25 metres to 30 metres and deeper. Waves and currents scoured the shelf clearing off sand and depositing this down the wall. A large rubble field covered the reef shallower than five metres, and hard corals on the shelf had been blasted and patches damaged by rubble flung by waves and storm surges.



Sediment flowing down the slope and wall

Hard coral cover of available suitable substrate averaged 27%, soft coral 27%, turf algae 15%, sponge 5%, crustose coralline algae 27%, and other organisms <1%. Coral colour was good, Table and massive coral colonies reached a maximum size of between two and three metres. The table corals had a full range of size classes. Coral recruitment was high and growth margins moderate for table *Acropora* but narrow for foliose and branching growth forms. Examples of coral lesion repair (x2), overgrowth of dead portions of the colony (x2), and reorientation of toppled colonies (x1) were few and contributed low scores to the recovery potential of this coral community.

Coral colonies on the shelf are small due to frequent turnover possibly caused by waves and storm surges

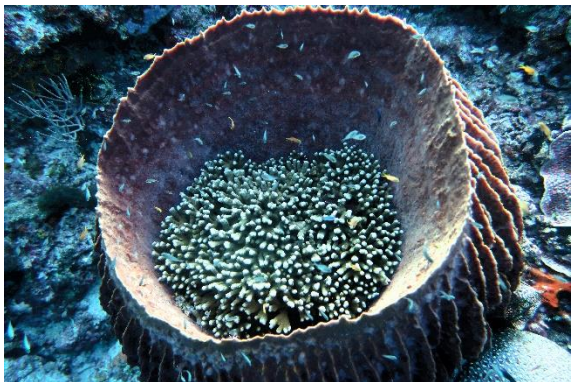
Crustose coralline algae were successful in consolidating rubble and covered dead coral surfaces, enhancing coral recruitment. Large dead boulder corals were covered by the crustose coralline algae and coral recruits.

Levels of coral disease and predation were low and moderate respectively. However, a strong current complicated examination of corals for evidence of these. This is a dynamic high energy reef with regular turnover of species.

Pincushion starfish, *Culcita*, feeding scars were evident, but the strong current prevented searching for the starfishes.

Overturned, dead table *Acropora*

Two distant rumbling volcanic blasts were heard and felt underwater and were quite different from the staccato, sharper blasts of explosives fishing.



Finger coral settled and thriving in barrel sponge

Hard and sift corals establishing themselves on the shelf

Fifteen large old dead table *Acropora* were observed shallower than five metres.

The stress resistance potential was high, and the recovery and overall reef health and resilience potentials of this coral community were moderate.

Serbete Wall South

22nd May 2023 Time in: 1100 Dive: 20 metres; 62 minutes

Coordinates: 8° 9'8.52"S; 123° 0'25.92"E

A variety of coral fishes bejewel the view above their coral sanctuary

Drifted with current along the wall stepped with ledges then up over shelf for most of the dive. The shelf was sandy, swept by current and covered by scattered coral bommies with a mix of hard and octocoral colonies or formed of single species *Lobophyllia*, *Porites*, *Diploastrea*, and *Goniopora* colonies.

Hard coral cover of suitable hard substrate averaged 12% and was considerably lower than the north section of this reef, octocoral 22%, turf algae 28% which was much higher than the north, sponge 5%, crustose coralline algae 28%, equal to that north, and hydroids 5%, a significant increase over the north. Coral colour was good. Table corals reached little more than one metre is size and had only a partial range in size classes. Massive coral colonies reached between two and three metres in size.

Coral recruitment was high and growth margins moderate for table *Acropora* but narrow for foliose and branching colonies. Examples of coral lesion repair (x1) were low, overgrowth of dead portions of the colony was not noted, and reorientation of toppled colonies (x4) were moderately represented.

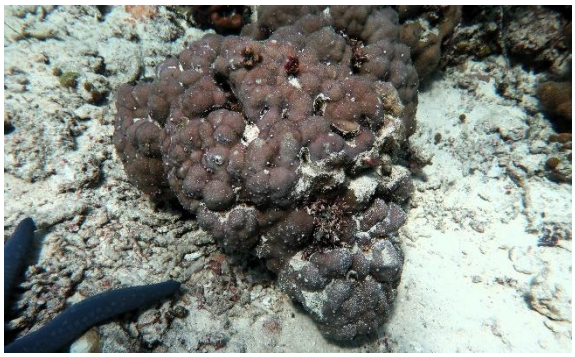
Levels of coral disease and predation were high.

Sediment and rubble cascading down the steep slope and wall was impacting corals. A high percentage of the hard corals there had evidence of sand and rubble abrasion, but this was not specifically recorded.

The stress resistance potential of this coral community was moderately high, but recovery and overall reef health and resilience potentials were moderate.

Octocoral dominated assemblage on sandy shelf

Large lobe coral, *Lobophyllia*, rises safe above the sand



Sediment-distressed boulder *Porites* coral

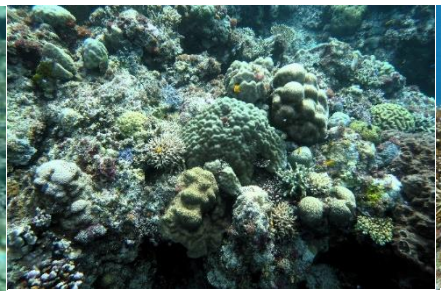
Anchor Bay

22nd May 2023 Time in: 1500 Dive: 14 metres; 65 minutes

Coordinates: 8° 4'50.76"S; 122°50'26.64"E

Easy dive down short wall and over rocky shelf with large boulders and scattered small corals. The wall was extensively covered by plating *Pachyseris* and *Echinopora*. One promontory was very scenic and surrounded by a variety of schooling fishes.

Large rock boulders on the shelf



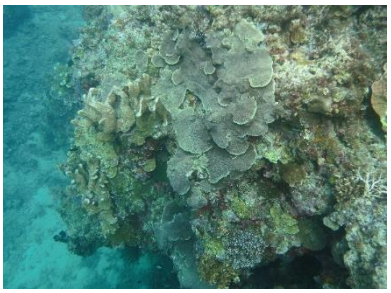
Small hard corals covering the outer shelf

Net fire coral, *Millepora dichotoma*

Hard coral cover on consolidated substrates averaged 38%, soft coral 7%, turf algae 22%, macroalgae (*Halimeda*) 15%, sponge <1, crustose coralline algae 18%, and other organisms <1%. Coral colour was good, but many *Seriatopora* exhibited early paling. Table corals reached and exceeded three metres, with a full range of size classes, but massive corals were smaller and barely exceeded one metre in size. Coral recruitment was strong. Growth margins of both table and branching *Acropora* corals were

Chameleon eye coral, *Diploastrea heliopora*, buttress below reef crest

Large plating *Montipora* coral growing over reef crest



Plating coral covered mini wall

moderately wide, and these were narrow for foliose corals. Three coral colonies exhibited lesion repair. Overgrowth of damaged portions of the coral colony and reorientation of toppled corals were noted for two colonies each, a low value.

Disease and predation levels were both high. Cobble stones, rubble and boulders rolling down the slope damaged live hard corals.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were moderate.

Tanjung Gedong

23rd May 2023 Time in: 0730 Dive: 25.6 metres; 60 minutes

Coordinates: 8° 4'23.10"S; 122°50'31.44"E

Dogtooth tuna, *Gymnosarda unicolor*

Entered over shelf with large, rounded boulders indicating periodic storm waves and surges tumbling them and rounding their edges.
The shelf led to a steep slope with numerous sponges and scattered small hard and soft coral colonies interrupted by extensive sand and rubble slides down the slope. The current was strong along the slope and over the shelf. Shallower than five metres was dominated by an assemblage of blue coral, *Heliopora*, fire coral, *Millepora*, and finger coral, *Porites cylindrica*. Hard coral cover of suitable substrate averaged 31%, soft coral 26%, turf algae 27%, macroalgae (*Halimeda*) <1%, sponge 4%, crustose coralline algae 9%, and hydroids 3% .

The soft or leather coral, *Sarcophyton*

Soft coral dominated patch on shelf

Hard coral dominated patch on shelf

Hard corals had good colour and no sign of heat stress. Table corals were smaller than two metres but had a full range of size classes within that limit. Massive coral colonies were all smaller than two metres in size. Recruitment of hard corals was strong. While the hard corals were actively growing, the growth margins for table, branching, and foliose corals were all narrow. Three coral colonies exhibited lesion repair, one had overgrowth of dead portions of the coral colony, and four colonies had reorientated their plane of growth after being toppled off their pedestals.

Outer shelf and upper slope dominated by hard corals

Coral disease and predation levels were high.
Nine large dogtooth tuna were observed and were welcome sights.
The stress resistance, recovery, and overall reef health and resilience potentials of this coral community on the reef shelf were moderate.

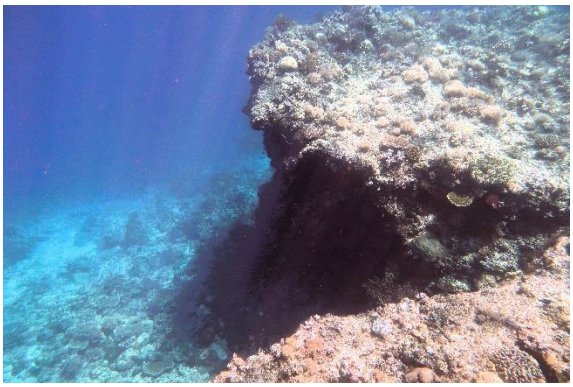
Black phase of ribbon eel, *Rhinomuraena quaesita*

Batu Payung

23rd May 2023 Time in: 1100 Dive: 23.3 metres; 60 minutes

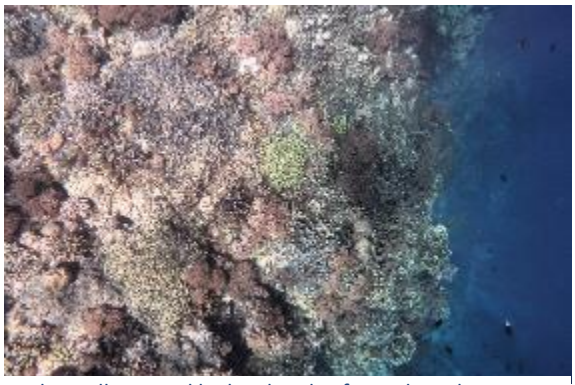
Coordinates: 8°13'22.95"S; 122°43'47.34"E

Easy drift dive along the reef in weak current. Reef slope cut by rubble and sand slides and debris cascading down damaged many coral colonies. Coral colonies on the wall appeared healthy. Plating *Montipora* were all angled out to catch the light. The reef was split in many places, presumably due to eathquakes, and falling away in large blocks.

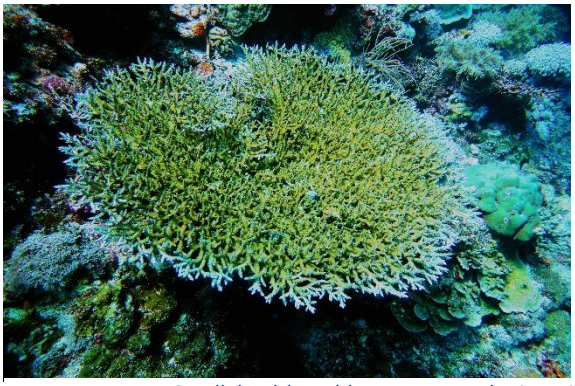


Splits in the reef rock caused by seismic activity are relatively common in this part of the "Ring of Fire"

Hard coral cover averaged 37%, soft coral 38%, turf algae 10%, sponge 3%, crustose coralline algae 11%, and other organisms <1%. Hard corals had good colour and no sign of heat stress. Table corals reached between two and three metres in size and had a full range of size classes. Massive corals were smaller than two metres. Recruitment of hard corals was strong, and corals were actively growing. The growth margins of table *Acropora* were wide and moderately wide for branching and foliose corals. No coral colonies exhibited lesion repair. Two



The wall covered by hard and soft corals and sponges



Small, healthy table *Acropora* colonies with wide pale blue growth margin on the left

corals had overgrowth of damaged portions of the coral colony, and reorientation of toppled corals was noted for five colonies.

The level of coral disease was moderate and of predation was high. Sand and coral rubble cascading down the slope and wall damaged or killed corals.
Despite this impact on corals, the stress resistance, recovery, and overall reef health and resilience potentials of this coral community were high.


The anemone *Actinostephanus*

Sea Lady Corner

23rd May 2023 Time in: 1500 Dive: 19.9 metres; 61 minutes
Coordinates: 8°13'49.41"S; 122°44'14.99"E

This was a heavily impacted reef. Islands of rocky outcrops were surrounded by extensive sand and rubble areas but provided habitat deeper than 25 metres for a large school of bohar snappers. Shallower than five metres one such rocky area supported an assemblage of blue (*Heliopora*) and blunt-branched *Isopora* corals and octocorals. Hard coral cover on the upper slope and shelf rocky outcrops averaged 22%, soft coral 8%, turf algae 50%, sponge 8%, crustose coralline algae 12%, and cover by other organisms <1%. Coral colour was generally good but about 5% of colonies were paling. A few table *Acropora* coral colonies exceeded two metres in size and tables had a full range of size classes. Massive corals were all smaller than two metres.


Robust growth forms typical of wave and current stressed coral habitats: boulder *Porites* (left) and stout branched *Isopora* (right)


Deep-coloured, healthy corals on reef shelf

Coral recruitment was moderate, and corals were actively growing. Table *Acropora* corals had moderate growth margins, but those of branching and foliose colonies were narrow. Lesion repair was not observed and only one colony with overgrowth of dead portions of the colony and two toppled colonies exhibiting growth plane reorientation were recorded.
The levels of coral disease and predation were both high. Multiple signs of compromised health (20 colonies) and borer infestations (14 colonies) contributed to these high scores. They were most likely the consequence of trauma and abrasion from sand and rubble blasting that was so conspicuous here.

This site had eight dead overturned table *Acropora* colonies and numerous boulder corals that had been rolled.

Hard corals and sponges had suffered massive distress from cascading sand and debris down the slope. On the shelf, hard corals appeared blasted by coarse sand and coral rubble during storms and high winds. The storms and winds would generate surges that traverse 800 metres over reef flat during the northwest monsoon, moving rubble and sand and blasting corals before dumping it down the slope and wall damaging corals it contacted.

Barrel sponge, *Xenospongia testudinaria*, and large sea fan, outer shelf

Mobile rubble and sediments on the reef slope compromise the health (*Porites* right) and kill corals, such as the table *Acropora* (left, centre)

The stress resistance, recovery, and overall reef health and resilience potentials of this highly distressed coral community were low.

Batu Payung Beach

23rd May 2023 Time in: 1830

Coordinates: 8°13'42.08"S; 122°44'20.10"E

Night dive. I did not participate.

Pulau Babi, The Crack

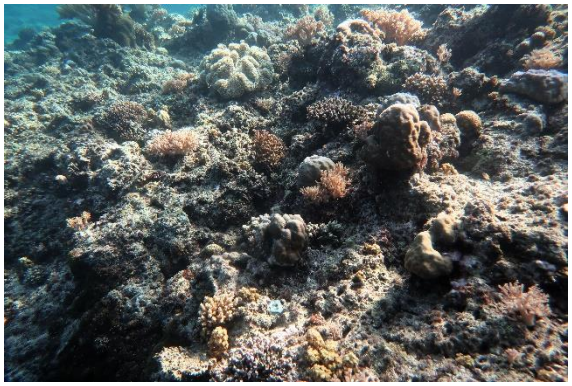
24th May 2023 Time in: 0730 Dive: 22.4 metres; 62 minutes

Coordinates: 8°25'34.56"S; 122°29'26.10"E

Easy drift along wall and back over shelf shallower than five metres. The shelf was plastered by crustose coralline and turf algae and a variety of small hard and soft corals. It sloped gradually and fell away abruptly down the wall. The wall had narrow ledges with sand deposits and a range of invertebrates, less than 10% cover of live hard and soft corals, and numerous sea fans, wire corals, and sponges. A piece of the wall had fallen away leaving cracks, caves, and overhangs. The shelf had an average of 20% hard coral cover, 22% soft corals, 28% turf algae, <1% macroalgae, <1% sponges, 30% crustose coralline algae, and <1% other organisms. Coral colour was good although about 1% of the hard corals, primarily *Seriatopora*, *Pocillopora*, and *Stylophora*, exhibited early paling. Table *Acropora* colonies reached a maximum size between two and three metres and had a full range of size classes. Massive corals were smaller than two metres.

Danny floats over narrow cracks in the reef caused by earthquakes

Earthquakes have split the rock shelf



Corals cover the rock surfaces between narrow cracks in the reef caused by eatrhquakes

Coral recruitment was strong. Corals were actively growing but with narrow growth margins, except for foliose corals that had moderately wide margins. One coral colony had active lesion repair and another had reorientated its growth plane after being toppled from its pedestal. Overgrowth of dead portions of a coral was not observed on any colonies.

Disease levels were low to moderate, and predation was high.

More than 80% of hard corals on the wall showed varying levels of damage from cascading rubble.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were moderate.

Encrusting *Montipora* coral lays out a red carpet for this regal angelfish, *Pygoplites diacanthus*

Blizzard of coral fishes over their branching coral refuge

Pulau Babi, South

24th May 2023 Time in: 1100 Dive: 22.4 metres; 63 minutes

Coordinates: 8°25'48.12"S; 122°29'29.10"E

Easy drift along wall and back over shelf in five metres. The shelf progressed over a steep slope to a sheer wall. The outer shelf and slope were split by deep crevasses and large chunks had fallen away forming caves and overhangs. The slope had rubble slides and tumbled old dead massive corals. These were covered by crustose coralline algae. Hard corals down the slope and on the wall were distressed by moving rubble that was caught up in the coral colonies. The wall supported numerous large sea fans.

Rubble and sediment slide down the reef slope and wall

Hard coral cover on the slope and shelf averaged 28%, soft corals 30%, turf algae 13%, macroalgae <1%, sponges 1%, crustose coralline algae 28%, zoanthids (*Palythoa*) <1%, and other organisms <1%. Coral colour was good. Table *Acropora* and massive corals were smaller than two metres and the tables had only a partial range of colony sizes.

Strong coral recruitment on bare rock on shelf

Coral recruitment was strong and growth margins for table *Acropora* moderately wide and narrow for both branching and foliose corals. Three coral colonies exhibited lesion repair, none had overgrowth of damaged portions of the colony, and one coral had survived toppling and reorientated its plane of growth.

The level of disease was moderate and of predation was high.

The stress resistance, recovery, and overall reef health and resilience potentials of this coral community were moderate.

Dambila

24th May 2023 Time in: 1500 Snorkel

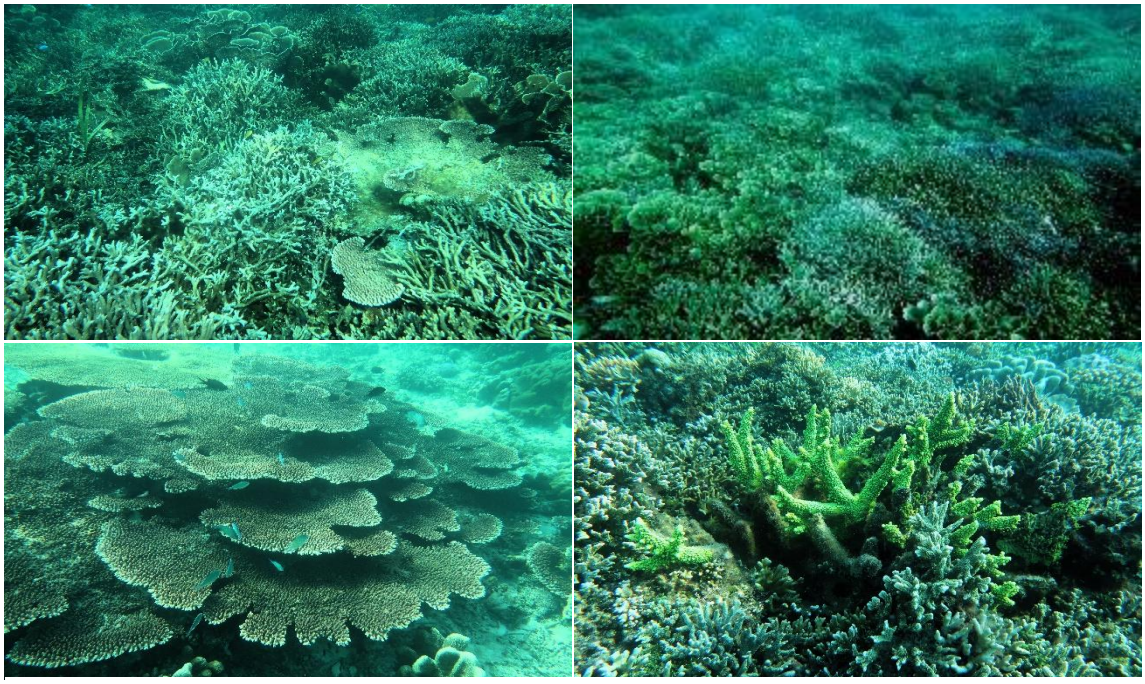
Coordinates: 8° 28.977'S; 122° 28.062'E

These observations are supplemented by notes from 12th May 2019 made while snorkelling. Water temperature 30C.

An extensive 1.2-1.5 metres deep shelf extended south of the island. The shelf was covered by extensive coral growth. Branching species of *Acropora* were predominant; and other conspicuous corals included table *Acropora*, *Porites cylindrica* and a boulder *Porites*, *Isopora*, foliose *Montipora* and *Echinopora*, faviids, *Stylophora* and *Pocillopora*. One large sandy patch had healthy scattered coral colonies and a great number of *Diadema* sea urchins. A juvenile hawksbill turtle was seen peering out from under coral and appeared unconcerned by the presence of snorkelers. Live hard coral cover averaged 80%, turf algae 18%, and sponges 2%. Coral colour was within the normal range with some very mild and early stage brightening overall.

Boulder *Porites* fields border the deeper margins of branching and foliose coral patches

Table corals approached two metres in size and had a moderate range in size classes. Massive corals were smaller than two metres. Corals were actively growing with moderately wide growth margins and recruitment was strong. Lesion repair was recorded for three branching coral colonies and growth plane reorientation for one branching coral that had been broken.



Shallow coralscapes of branching and foliose corals and occasional large table *Acropora* are characteristic of Dambila

The level of disease was moderate and of predation was high. One pincushion starfish was seen and feeding scars were noted. Eight cases of predation by an unidentified predator were observed. At least

one of these had the pattern of *Drupella* predation but no snails were seen. They were possibly buried too deeply into the tightly branched coral colonies.

Heavy turf algal growth will cause demise of these coral colonies

In 2019, this was a well-established coral community in a shallow habitat and susceptible to stress. However, despite their apparent strong stress resistance and strong recovery potential in 2019, the corals showed a great reduction in both these values during our 2023 visit. This could be due to the heavy growth of turf algae on many coral colonies, possibly due to overfishing of herbivores such as parrotfishes, surgeonfishes, and rabbitfishes.

Overall, the resilience potential of this coral community had dropped from high to low since 2019. Stress resistance potential was low and stress recovery potential was moderately low.

Dambila Dive 2

24th May 2023 Time in: 1500

Coordinates: 8°29'5.40"S; 122°27'51.12"E

I did not participate, opting to snorkel instead.

Dambila Dive 3

25th May 2023 Time in: 0730

Coordinates: 8°29'5.40"S; 122°27'51.12"E

I did not participate; went to hospital with Chuck and Foued.