

Coral reef monitoring in the Republic of the Marshall Islands

Progress Report 2011- 2012

Organization/Contact: Micronesian Conservation Trust, College
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2012 Majuro Final Report

Due to the unnecessary and misguided coral mining operations of a contractor that have begun at the reservoir area of Majuro lagoon, to provide an enormous amount of fill for the FAA-funded RSA project (runway safety area), much time was spent lobbying RMI and US agencies to save at least part of the reef within the approved dredge zone from destruction. However, several serious new developments were noted: an invasive outbreak of a macroalgae, *Hypnea*, on Majuro, and a catastrophic COTS outbreak at the northern tip of Arno atoll. Also, over four years of accumulated data on the Ajeltake coral disease outbreak involving massive corals (principally *Hydnophora*, *Platygyra* and *Pavona*) was presented at the Cairns Coral Reef Symposium and published in the Proceedings.

Site Name	Coordinates		Number of Visits	Visit Dates
	X	y		
Reservoir lagoon	7 04' 53.48" N	171 17' 21.32" E	5	Between May and Sept 2012
Picnic reef (lagoon)	7 03' 45.53"	171 15' 29.81"	1	Oct 22
Bridge (ocean side)	7 04' 52.48"	171 21' 14.12"	2	Oct 3
Uliga-CMI (reef flat, ocean)	7 06' 11.67"	171 22' 49.82"	3	Oct 15
Seawall (Ajeltake ocean side)	7 03' 26.51"	171 12' 43.22"	>5	Numerous 2011-2012
Laura radio tower (ocean)	7 07' 47.69"	171 02' 35.31"	2	May 4, Sept 15
Arrak (ocean)	7 07' 16.90	171 03' 00.58"	1	Aug 24
North Point, Arno	7 17' 28.09"	171 38' 32.62"	1	Sept 7
Ulien Point, Arno	7 07' 44.65"	171 33' 47.07"	1	Sept 7

Methodology:

Snorkel swims from shore, at permanent sites, usually to re-visit specific, individually memorized massive coral colonies to monitor progress of coral disease infections, photographs taken using an Olympus Stylus 1060SW pocket camera (10 mp images) or a Sony DC858 camera in an Ikelite Housing. Photos usually taken after 5 pm for optimal "flat" lighting. In the case of the Arno north point visit, a SCUBA dive down to 25 meters on Arno was documented using the still-photography function of a Sony HC-1 HD video camera in an Ikelite Housing.

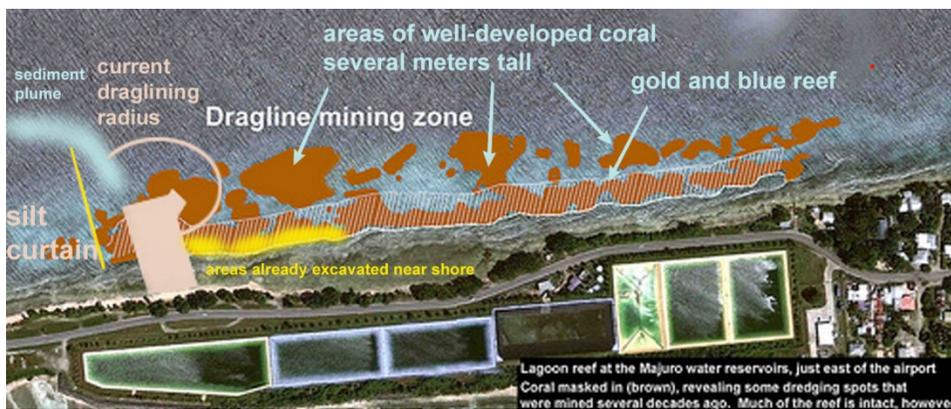
All data collected by Dean Jacobson, who was in Manila in late June, in Australia for most of July, and sick for much of August.

Coral dredging:

Coral Mining in Majuro lagoon, in front of the water reservoirs, began in mid-August. In the context of Majuro lagoon, the reefs near the airport are among the healthiest, most intact, with the highest coral cover of any of those remaining. Much of the rest was killed during the COTS outbreak and has not even begun to recover due to a nearly uninterrupted blanket of *Halimeda* and *Asparagopsis* algae that became established on dead coral surfaces after 2005. One part of the reservoir reef, approved for dredging without public hearing, EIA or even a cursory underwater inspection by EPA, features a remarkable, stunning community of yellow branching *Porites* and a violet *Pocillopora* (appearing blue), the later not found at any other known site. The juxtaposition of these unusually colorful coral is visually splendid. This “gold and blue” locality is also a gathering point, in the evening, of hundreds of young mullids (yellowfin goat fish, *Mulloidichthys vanicolensis*).



Fortunately, the new US ambassador in Majuro, Tom Armbruster, has taken an active interest in this affair, and is making attempts to bring all sides of the issue together at the embassy. Earlier in October, Tom invited me to the embassy for a long personal meeting to brief him on coral issues. The first group invitation, for a meeting on Monday October 22, was however largely ignored by the RMI govt and by the contractor. Only one Marshallese official, a proxy for Secretary Kasten, attended (along with two low-level EPA staffers), besides myself and Steve Why, a conservationist who now advises the RMI govt at OEPPC.

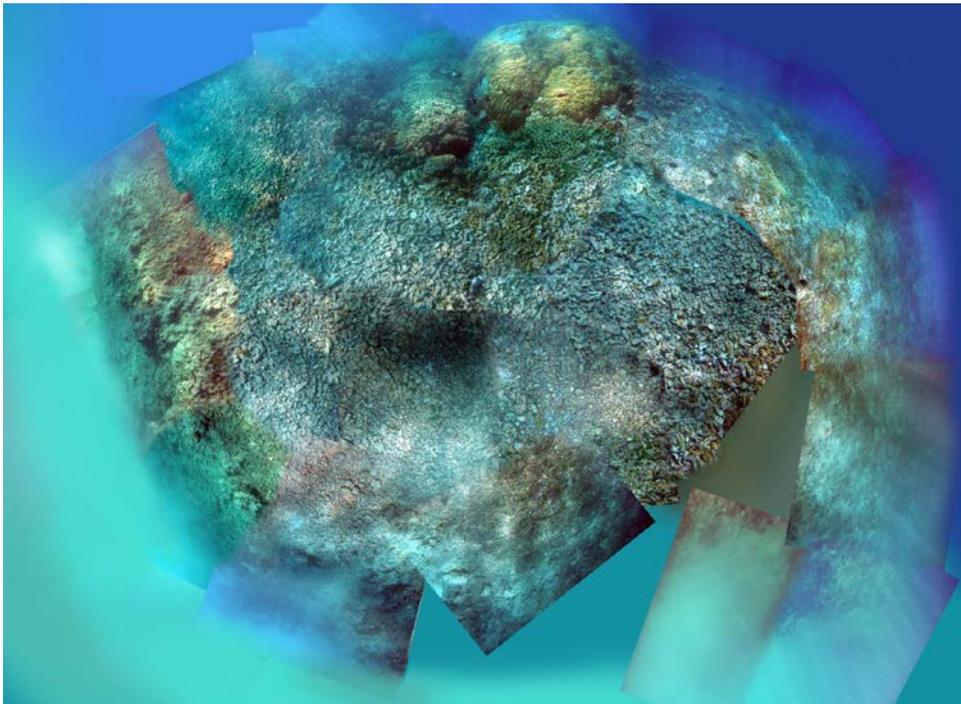


Current extent of coral mining activities at the Majuro reservoir site.



Hopefully, subsequent meetings will be better-attended, particularly in light of the authority recently granted by President Obama to Mr. Armbruster over the FAA project. I recently learned (on the weekend before the embassy meeting, when I snorkeled the RSA site) that the contractor had illegally dredged the shallow reef at the end of their rock off-loading ramp, in violation of the 29 June 2011 FAA instructions that dis-allowed the contractor from obtaining fill from the “Picnic Reef” at the west end of the runway. In response to my last visit to this reef (for which I requested in writing official permission from EPA weeks earlier, but never received a response) the contractor attempted to have me arrested by National Police. I was careful to stay far away from any of the contractor’s operations, but I was forced to make the visit in order to have up-to-date information for the embassy information-sharing meeting. I was able to convince the police that PII had no grounds for making the charge against me. (They do not, after all, own the lagoon!)

In the 360 degree mosaic below, the bottom of the image shows the edge of the dredged borrow pit, the top shows the edge of the dropoff. This now devastated reef, reduced largely to rubble, was the site of a spectacular *Ctenochaetus* (surgeonfish) spawning aggregation that I videotaped last year.





Newly discovered borrow pit



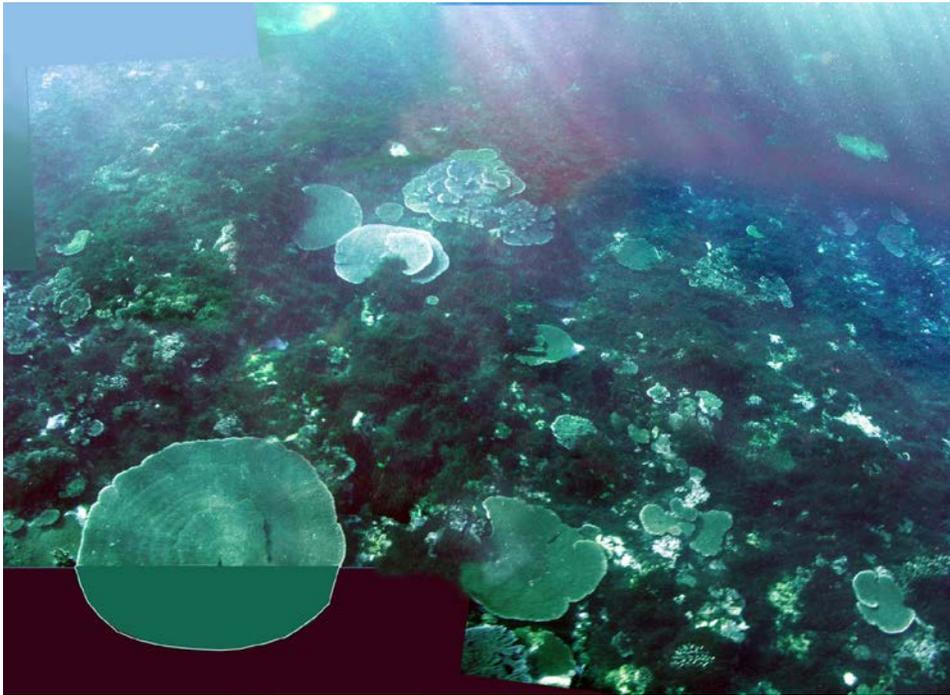
In early October a very long sediment plume was seen extending across the lagoon reefs from the RSA fill area (note the absence of silt curtains) but upon inspection very little sediment could be found on the coral here. A new, very well-configured silt curtain, lacking gaps or holes, is now in place (the eastern end anchored onto a live *Porites* colony), but it does not yet completely enclose the fill zone, and does not extend to the area where the plume was documented (above).

***Hypnea* invasion**

Earlier in 2012 a large number of algal clumps began appearing on the reef flat near the bridge. Upon inspection in September, it was revealed that a continuous thick blanket of *Hypnea* algae (which appears brown or olive green in life, but becoming purple after many minutes of exposure to air) now extends from the MEC fuel tank farm to a point a few hundred meters west of the bridge, covering approximately a kilometer of reef, extending from intertidal dredge pools all the way across the shelf to the edge of the dropoff. The large majority of coral are dead, “submerged” beneath the blanket, with only the largest, tallest colonies, mostly tabulate *Acropora* spp, surviving. This algae appears to bleach coral on contact. A small scale algae-removal attempt was made within the boat channel, lagoon-ward of the bridge, and after rinsing and drying the algae was composted. *Hypnea* has also appeared near CMI on the reef flat, as the outer-most band of a system of pollution-adapted algae (most of which is a green *Enteromorpha* sp, with *Cladophora* covering the reef flat nearest to shore).



This *Hypnea* invasion is perhaps the greatest threat to biodiversity and ecosystem function yet encountered on Majuro, as it removes a crucial food resource (whisker algae growing on hard surfaces) needed by scarids, acanthurids and many other fish. Its proximity to the Delap sewage outfall (in bad need of replacement) is probably no coincidence.



Fore reef shelf several hundred meters east of bridge looking towards shore, densely carpeted with *Hypnea* sp.

Two permanent photo-transects (across the reef shelf, normal to the shoreline) were established west of the bridge and ahead of the spreading mat of *Hypnea*, which will allow measurements of the rate of growth and “infilling” of the spreading mat.

Bleaching

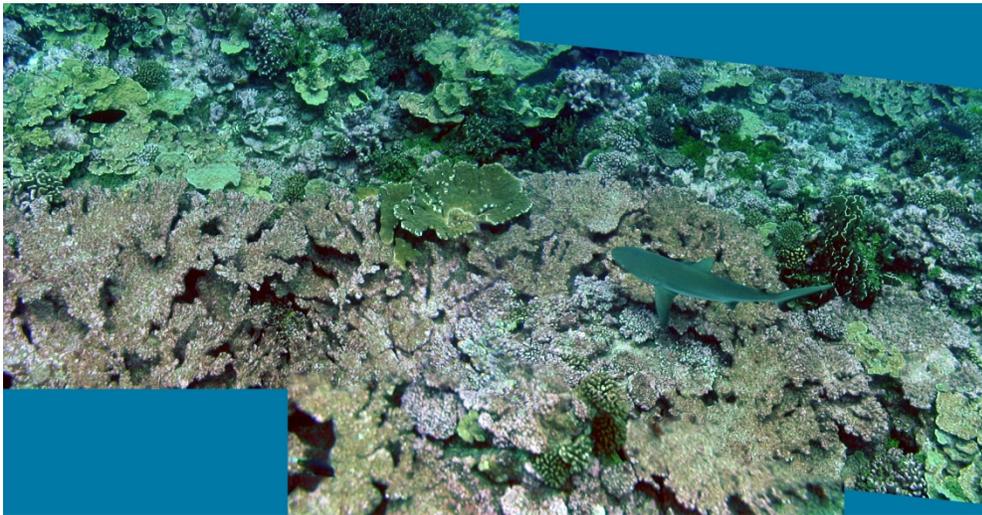
It was also noted that nearly all the fast-growing *Acropora digitifera* population out on the reef flat near CMI, just sea-ward of the *Hypnea* band, have become bleached and, roughly 50% subsequently died in October 2012. The large zooxanthid mats also bleached. This event is not overly worrying, as it follows at least three previous bleaching events since 2002; this coral population has repeatedly re-grown following these repeated mortality events. Subtidal corals have not yet bleached (they last did so in 2009). Note that exposure to air during low tide does not necessarily cause bleaching, the coral need to be “pre-stressed” (i.e. by high water temperature).



COTS outbreak on Arno

In recent years, since 2009, a gradually increasing COTS population on Arno Arno has been observed. Thus, the COTS population on Arno has lagged behind that of Majuro, which exploded in 2004-2005. Earlier in 2012 it was found that these predators had migrated into the shallows and discovered the "Pacific elkhorn" *Acropora*. This coral (possibly a sister species or variant of *Acropora abrontanoides*) is so rare and distinctive that its discovery on Arno warranted a well-publicized international press release by Zoe Richards. This coral, unfortunately, also turns out to be preferred food of *Acanthaster*: nearly all were eaten completely, up to the tips of the long branches. I rescued two surviving branch tips and am culturing them in situ using a suspended line method. I also witnessed the first small feeding scars on the giant *Leptoria* brain coral, an ancient colony of a rare species; such a large colony has not been seen on any other atoll (excluding its twin, a second giant *Leptoria* colony at the same site, just 10-15 meters to the north!)

On a recent, unexpected visit to the North Point of Arno atoll, as the guest of two shark conservationists filming a documentary on the RMI Shark Sanctuary, I discovered that all the coral visible at 80 feet (one giant *Lobophyllia* and countless thousands of smaller massive *Porites* colonies) were dead, clearly the victims of *Acanthaster* predation. Indeed, in the shallows (less than 30 feet) I found fresh feeding scars on *Montipora*. Here in the shallows nearly all the *Isopora* and *Acropora* were dead. Over half of the *Montipora* survived, and the *Heliopora* blue coral colonies were untouched. I found a very large *Leptoria* that had only 10% of the living tissue, on the upper most surfaces, remaining. The final dive, at Ulien Point far to the south (but north of Arno Arno) found a healthy *Porites* reef with no mortality, it was (so far) untouched by COTS. The geographic extent of the Arno COTS outbreak needs to be determined. The event at North Point is the most devastating COTS mortality I have ever witnessed. COTS outbreaks have been linked to coastal eutrophication. Given the lack of significant local sources of pollution on Arno, it is possible that advection of COTS larvae via ocean currents may have brought the outbreak to Arno from Majuro.



Reef shelf showing nearly complete loss of *Acropora*, surrounded by surviving *Montipora* and *Heliopora*.



Below dropoff, at 80 feet, showing dead *Lobophyllia*; none of the background *Porites* colonies survived.



None of the *Isopora* shown here survived. Algal overgrowth is minimal, showing low nutrient levels.



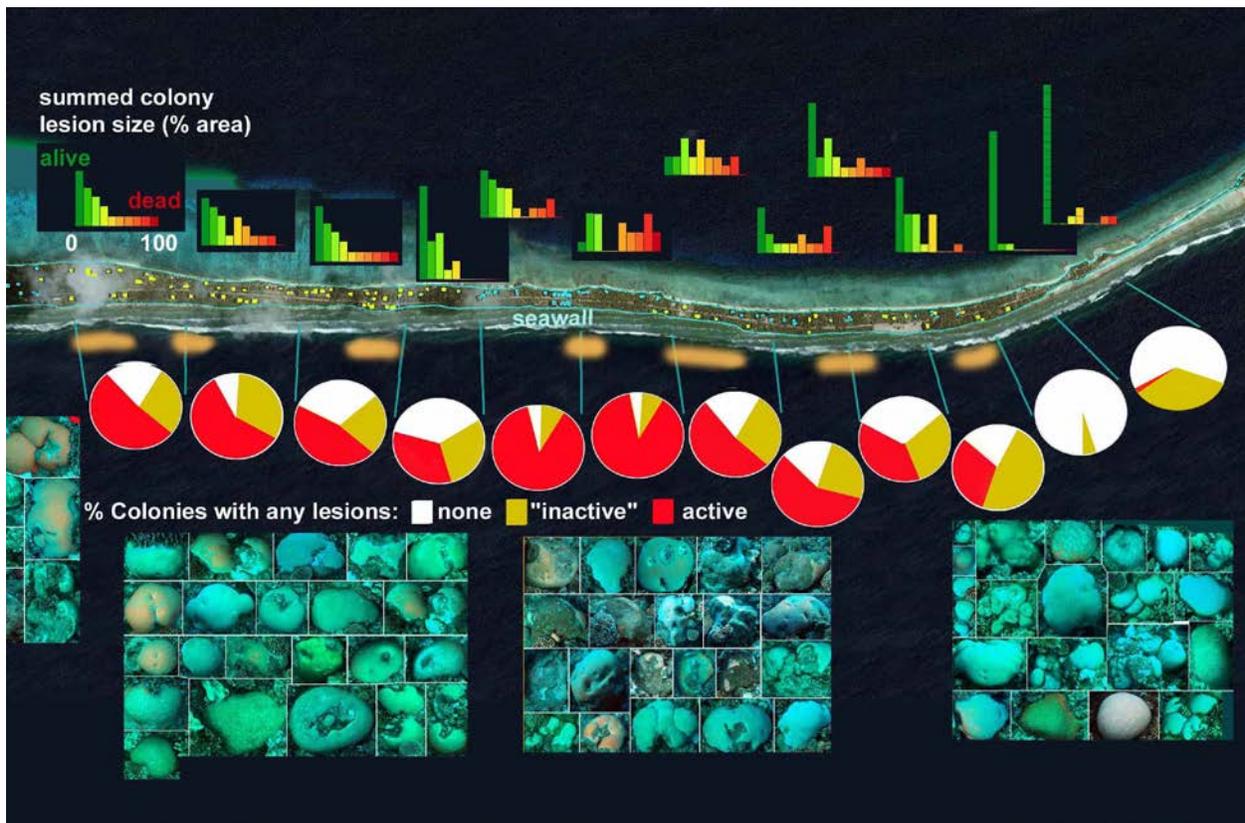
A rare *Leptoria* colony at Arno's north point, nearly completely consumed by COTS. Note dead *Acropora* at right.

Ajeltake coral disease study

A comparative study of massive corals (almost exclusively *Hydnophora microconos* and *Platygyra sinensis*) found at a dozen contiguous sites along 5 km of the eastern Ajeltake shoreline (from Peace Park to the Elementary School) was completed this summer. The results were presented at the Cairns International Coral Reef Symposium in July, and published in the Proceedings. Every encountered colony in the mid-shelf reef was photographed in an unbiased manner; each cluster of 20-25 colonies was pooled and analyzed separately for the presence of either actively spreading or seemingly "dormant" lesions. The results are shown as pie charts. Note also the histograms at top that show the amount of colony surface that has been killed by disease. (COTS feeding activity is non-existent here). The take home lesson is that disease is nearly or completely absent at Peace Park, at the eastern side, where no homes or sources of sewage are found. Disease increases in direct relation to the presence of permanent homes. The geographic extent of the disease outbreak is at least 15 km. To the west of this zone disease drops to low levels, and is undetectable in Arrak. However, further to the west in Laura, a moderate level of algal over-growth is killing some of these corals. Given that nearly all the colonies in Ajeltake are infected, it is anticipated that none will remain alive within 5-10 years. Indeed, there are areas in Ajeltake, to the east of Ajelake Elementary school, where none of these coral colonies are alive. Only dead skeletons can be found.



Final year of the first diseased *Hydnophora microconos* colony to be documented (began in 2007).



Brown segments indicate the presence of brown, turbid water, causing very low visibility, possibly caused by “submarine nutrient flows” originating from septic tanks. Existing homes are shown as yellow and blue dots. The “seawall” site, with a closely-arranged cluster of rental apartments, is the longest-studied and most closely monitored region. Prior to 2005 this reef was far more attractive, with much less disease, and far more coral and anemone diversity, than is now the case. The process of degradation and decline here has been rapid.

A new site was documented at Arrak (in front of the CMI campus); 50 *Hydnophora* and *Platygyra* colonies were photographed, showing that these colonies are here larger and far more healthy than anywhere in Ajeltake (west of Peace Park). Housing density is very low in this region.

Actions and Conclusions:

Information on coral disease, the algal invasion at the bridge, coral dredging, etc. has been shared with Majuro Local Government and with the new US ambassador, Tom Armbruster. Three strategies for reducing nutrient loading were suggested: replacing the corroded sewage outfall pipe, investing in composting toilets, beginning with Ajeltake, and using a dry litter system for pig pens, putting pig waste in compost piles for use in gardens rather than on the reef flat. It is unlikely that much progress in these three areas will be seen in the next few years, since there is very little sense of urgency on Majuro with regards to coral health, despite the graphic, well-documented information I have been providing for years and continue to provide.

In summary, this has been a bad year for coral health on Majuro, and for coral protection. It is unlikely that the US government, through its embassy on Majuro, will intervene to stop US-funded coral mining. The chances of reducing the nutrient loading on Majuro reefs is, to, to reiterate, even lower. Coral reef

ecology is at the very low end of a very long list of pressing concerns and priorities in the RMI, despite the official declaration by former President Note regarding the Micronesia Challenge.