Explorers Club Flag Expedition Report: Flag #112


Nicole Crane, FN’97

With the participation of our Research Team:

Avigdor Abelson, Giacomo Bernardi, Nicole Crane, Peter Nelson, Michelle Paddack, Kristin Precoda, John Rulmal Jr. and Sara Cannon (graduate student)

With the participation of the Support and youth Teams:

Rick Saber, MN ‘01, Alessio Bernardi, Amalia Bernardi, Deena Brabant, Shanthi Russel, Cole Charlton, Kelsey Doyle, Samantha Stone, and Lucas Battles – along with our great Ulithi youth team: Austin Hapathelul, Keenen Paliyoruy,, Shawn Haped, Mailo Tasopulu, Tiffney Hasudepey, Skyline, Xina, Bertha
Project Overview:

Our Science Team, in collaboration with local teams and communities, has been conducting research for sustainable management and a better understanding of coral reef ecology in the remote outer islands of Yap State, Federated States of Micronesia, since 2010. The One People One Reef project is a unique project that is working to sustain communities, culture, and coral reefs across the Outer Islands by linking science with traditional management.

Super-Typhoon Maysak hit the Federated States of Micronesia on March 31, 2015. This flag expedition was to Ulithi Atoll, one of the areas most severely affected by the storm. Participants included OPOR project leader and Explorer Club member Nicole Crane FN ’97, and Explorer Club member Capt Rick Saber MN ’01, together with co-leader John Rulmal Jr and research team members Avigdor Abelson, Giacomo Bernardi, Peter Nelson, Michelle Paddack, and graduate student Sara Cannon, and support team Alessio Bernardi, Amalia Bernardi, Deena Brabant, Shanthi Russell, Cole Charlton, Kelsey Doyle, Samantha Stone, Lucas Batties. Ulithi youth team members included Austin Hapathelul, Keenen Paliyoruy, Shawn Haped, Mailo Tasopulu, Tiffney Hasudepey, Skyline, Xina, and Bertha. Land structures (houses, churches, and schools) were extremely damaged, and much of the vegetation (including coconut and breadfruit trees) was uprooted. Our purpose was to assess the reefs, which are critical to the livelihoods of the people who live here, and to their islands. The research team evaluated coral damage, coral cover, and fish diversity and biomass. The support team helped in obtaining scientific data, as well as engaging the local youth to assess the health of the reefs. While our original goal was to collect needed data in this poorly studied region, Typhoon Maysak changed our focus to direct our efforts towards assessing typhoon damage to the reefs.
Regional Geography: The Federated States of Micronesia (FSM) is an autonomously governed island nation (with autonomous governance by individual island communities) in the Western Pacific, and is a part of the US Compact of Free Association. The FSM consists of 4 States: Yap, Chuuk, Pohnpei and Kosrae. There are approximately 607 islands with a combined land area of 702 Km² (271 Mi²), and a population of 103,395 people (2012 census). The FSM covers more than 2,600,000 square kilometers (over 1,000,000 square miles) of ocean in the Western Pacific (Caroline Islands). The autonomous nature of governance and traditional land and ocean tenure rights make this a region well suited for locally driven management and conservation.
Yap State consists of 138 islands and atolls, 22 of which are populated, extending approximately 800 Km (500 miles) eastward into the tropical western Pacific. Although the islands encompass over 100,000 square miles of ocean, the state consists of only 45 square miles of land, much of which rises barely above sea level (the main island of Yap is a ‘high’ island). The 2000 census estimated a population at that time of 11,200 people. Although Yap State is a collection of islands, ‘outer islanders’ – people from islands other than the largest main island of Yap – often have a strong sense of cultural identity, and in many cases their culture differs significantly from communities on the main islands, including the language and leadership structure.

Ulithi Atoll is one of the outer island atolls of Yap state, lying approximately 100 miles east of the main island of Yap. The lagoon, 36 x 24 Km (22 x 15 miles) encompasses 548 Km², (212 Mi²), and is one of the largest on Earth. It consists of 40 islets (including 4 inhabited islands), collectively making up only 4.5 Km² (1.7 Mi²) of land, most barely more than a meter above sea level. The total population of Ulithi is about 1000, depending on time of year (it has one of the two high schools in the outer islands, to which youth come during the school year from the neighboring islands, including some outside of the Atoll). The 4 inhabited islands are Falalop (which lies just outside the main Atoll)- the largest in Ulithi, which has a population of between 500-700 people; MogMog, the governance and spiritual center of the outer islands, with a population of approximately 150; Asor, with a population of approximately 70; and Federai to the Southeast, with a population of approximately 150.
A shallow reef at Loosip, one of the Crab Islands outside the main Atoll (Falalop jurisdiction)

Project Explanation:

Background. Typhoon Maysak (known in the Philippines as Typhoon Chedeng) hit Ulithi Atoll, Yap State, Federated States of Micronesia, during the night of March 31, 2015. Winds gusts in excess of 210 Km/hr were recorded. Storm damage mostly occurred in the northern portion of the Atoll, where three inhabited islands, Falalop, Asor, and MogMog, are located. Severe damage also occurred at the fourth southern inhabited island of Federai. On land, the majority of the structures were damaged, with most roofs being removed by the storm. Coconuts, a potential source of water and food, were destroyed, and the majority of coconut and breadfruit trees were uprooted.

Ulithi islanders rely on the reef for protection from the waves and erosion, as well as for protein from fish and, to a lesser extent, octopus.

Goals. The research team has been conducting reef monitoring in Ulithi for the past four years. The goal of this expedition was to assess reef health after Typhoon Maysak, and collect samples for genetic analyses to estimate coral dispersal due to the Typhoon. We also sought to sample 28 sites to compare them with past years.

Specific objectives

1. Understand natural ecosystem structure and function through reef surveys, and collecting samples for genetic analysis of unusual species. In particular,
we sought to study the ‘weedy’ and potentially harmful coral *Montipora* sp., which has been overtaking other corals on reefs in close proximity to villages.

2. Document traditional management and fishing practices and recent changes through interviews, and community meetings and activities. Specifically, we sought to better understand the impact of the typhoon on the people and their livelihoods.

3. Co-create adaptive management plan frameworks by working with community members and leaders.

4. In collaboration with the Clean Oceans Project, take a plastics to fuel conversion demonstration unit to test the applicability of a plastics to fuel conversion system in the outer islands (unit already acquired). Fuel availability is tied to fishing practices. 

   **We were unable to take this unit due to logistical constraints and post Typhoon priorities. But we were able to discuss future plans with the communities.**

5. Conduct outreach and dissemination activities to reach a broad audience to share the expedition findings. In particular, take a group of US youth to engage with Ulithi youth in reef management and conservation, as well as rebuilding efforts.

In summary, this expedition highlighted the union of exploration, scientific advancement, local knowledge and leadership, and youth engagement.

**Project participants**

Nicole Crane, FN 97, served as Project Leader. She is a professor of Marine Biology at Cabrillo College, Santa Cruz County, California, and a senior Conservation Scientist with Oceanic Society with extensive field experience. She was born in Afghanistan and lived in several countries including Jordan, Nepal, Zaire, Haiti, and Greece, before boarding her parents’ sailboat and crossing the Atlantic. She lived underwater for ten days in the Aquarius underwater habitat in Key Largo, Florida, and led multiple research trips to Belize, the Bahamas, and Micronesia. She has been working on the reefs of Ulithi Atoll since 2009, with co-leadership from John Rulmal Jr. For this expedition they were joined by Avigdor Abelson, Professor at Tel Aviv University, Giacomo Bernardi, Professor at the University of California Santa Cruz, Peter Nelson, Researcher at H.T. Harvey and Associates, Michelle Paddack, Professor at Santa Barbara City College, and Sara Cannon, graduate student at the University of British Columbia. The research team has been working together in Ulithi since 2012. The support team was composed of Capt. Rick Saber MN ‘01, who has led multiple expeditions in the Himalayas, high school students Lucas Batties, Amalia Bernardi and Alessio Bernardi, as well as college students, Deena Brabant, Shanthi Russell, Cole Charlton, Kelsey Doyle, and Samantha Stone, and Ulithi youth team members Austin Hapathelul, Keenen Paliyoruy, Shawn Haped, Mailo Tasopulu, Tiffney Hasudepey, Skyline, Xina, and Bertha.
Nicole Crane FN’97, Rick Saber MN’01, John Rulmal Jr.

Research and support teams with local people at MogMog, Ulithi Atoll.
Project Methods

Thirty two sites were visited in Ulithi Atoll. These sites included all the inhabited (Falalop, Asor, MogMog, Federai) and most of the uninhabited islands, including the remote turtle islands (Geilob and Loosiep). Sites were also chosen for assessing reefs inside and outside areas that have been locally managed (protected areas).

Map of sites (red stars) where reefs were assessed.
Flag at the southern site of Yealil.

Flag at Geilob (Turtle Island).
Sites were assessed for fish and corals. Fish diversity and abundance were estimated with 50 meter x 5 meter belt transects, and all fish were identified to the species level, counted and sized. Coral cover and complexity were estimated using ¼ M² quadrats. Recruitment of new corals was also assessed using night UV light and yellow filters that allow for finding minute recruits on the reef. In addition, a weedy coral (genus *Montipora*) was extensively sampled for genomic analyses (which will be performed later in California).

*Amalia Bernardi measures coral sizes along a transect.*

**Expedition Results.** For a report of our 2011-2014 results, please see our website onepersononereef.ucsc.edu at this link: http://ulithimarineconservation.ucsc.edu/news/

Our goals this summer were to conduct post-typhoon reef assessments as well as include youth from Ulithi and youth from California in the work. This latter goal was seen as a youth cultural exchange where both groups could learn from each other, and learn about the importance of reef management in general. We accomplished more than we had hoped, and added a large research component due to the ‘just in time’ receipt of a National Science Foundation grant to study the effects of Maysak on a species of coral on Ulithi (*Montipora* sp.).

We were also able to meet with the Ulithi community on Yap, as well as the Ulithi community on Kona (thanks to Max Yarawamai for organizing, Xavier Fethal for skyping in from Honolulu, and John Rulmal JR for skyping in from Yap). Our collective goal of having the islands and communities unite around resource management, and preserving both the natural and cultural resources and traditions, is being realized. Now, more than ever, we need to work together during a time of rapid change – both with the environment and with traditional practices.
We will be analyzing our data and findings over the next months, so these notes are qualitative in nature, but serve to provide a general overview of what we found. Please stay tuned for our upcoming report.

We had a very productive summer, thanks to so much support and collaboration from all the communities. The generous communities of Falalop, MogMog, Federal and Asor welcomed us warmly. We worked closely with John Rulmal JR, as well as meeting with the local science teams from the four islands. Despite extensive destruction from Typhoon Maysak, the communities welcomed us to help them assess their reefs, which are a critical source for food as well as shelter for the islands. This is truly a collaborative effort, and it was never more evident than this past few weeks! We also carried the Explorers flag #112 (explorers.org) as an honor to this work, the people of the outer islands, and the beautiful islands themselves.

Kelsey Doyle and Sara Cannon, with help from Amalia Bernardi, conducted numerous interviews with community members. Kelsey is creating a documentary with these results. We were able to gather stories about individual experiences of Typhoon Maysak, as well as impressions of management and the role of reef closures. In general, people were very positive about the management; they not only felt it was working to enhance fish populations, but many said that as a result of reef closures prior to the Typhoon, they were able to open those areas and have ready access to fish just after the Typhoon and before relief had arrived.
Below is a summary of our science work this summer on Ulithi’s reefs:

Thanks to the help we received from the youth teams, local teams and our science team, we sampled 32 sites across the Atoll (see sites diagram above), including sites from each jurisdiction: Asor, MogMog, Federai and Falalop. We counted over 11,000 fish and collected data from 620 quadrats (the sampling we use on the reefs to assess coral cover, algae cover, etc.). We conducted a study of Montipora (cabbage coral) fragmentation (to see how far the typhoon ‘threw’ pieces of the Montipora coral), and tested the Baited Remote Underwater Video (BRUV) design to count fish at deeper and more remote sites (the BRUV apparatus built and made possible by the Lab of Dr. Steve Moore, see: https://csumb.edu/eel).

Observations on Montipora (cabbage) coral:
We were particularly interested in looking at the effects of Typhoon Maysak on this coral. It is a ‘weedy’ fast growing coral that appears to have “invaded” some of the lagoonal sites as well as Falalop, especially sites near villages. It appears to be outcompeting other corals, and local residents say it began outgrowing other corals between 20 and 40 years ago. In general, the Montipora suffered heavy physical damage from the Typhoon (at MogMog men’s house, Falalop men’s house, Asor landing, Fetabul lagoon site and to a lesser degree Federai landing), but shows signs of fast recovery at all sites. Montipora was present at all sites except Pig and the Turtle Islands, and appears to be increasing at some Falalop sites. We will be conducting studies this year to try and assess the impact of the Typhoon on the dispersal, growth and re-establishment of this coral.

Other observations:
- Big branching corals were broken up by the Typhoon – this reduces reef complexity and habitat for fish.
- Fish diversity did not appear to change much as a result of the typhoon (2015 data appear similar to 2014). In fact, diversity within sites seems to have changed little since our first trip in 2012. This may change over time, depending on recovery of the reef benthos.
- Fish abundance may have been enhanced through management. There is some evidence that areas near villages that are more closely managed for fishing (i.e. some fishing occurs but is limited) are more similar to the most remote sites, known to be fished rarely. This may be an indication that management has been effective. Management was implemented on these islands following our initial visits and surveys, between 2011-2014.
- Reefs identified as compromised previously (with high incidences of Montipora, low diversity & cover, high incidences of algae and/or cyanobacteria) seemed to suffer more structural damage from the Typhoon than the more ‘pristine’ reefs.

Observations of the reefs:
Overall, Typhoon Maysak affected the reefs differently across parts of the Atoll. Just as on the islands themselves, some reefs were heavily damaged with high
percentage of breakage and algal regrowth, while others seemed minimally affected, with only the large branching corals showing breakage. On the more heavily impacted lagoonal sites, we noted a prevalence of a dark cyanobacterial turf covering broken corals and reef bench. Reefs that we identified as Montipora-dominated in previous years were littered with broken bits of coral, often blanketed by a dark, slimy cyanobacteria. New coral colonies on the rubble were evident, and sometimes abundant, but these were overwhelmingly more Montipora than other species. Evidence from other regions that have suffered typhoon damage to reefs suggests that fish populations can recover, but their recovery (or persistence) is tied to reef recovery (habitat recovery). If the habitat continues to degrade or recovers too slowly, it is likely that fish populations and diversity will suffer. *It is therefore imperative that these islands and communities receive support for reef recovery and resource management. This will be critical for future sustainability and climate change adaptation as the systems continue to experience change.*
An intact reef (west facing – Yealil island

Asor’s reefs:
We sampled the reefs in front of Asor, including the landing (lagoonal), Matalyoch (more exposed to open ocean water through the channel between Asor and Falalop), and Lamoor. These reefs had all been ‘damaged’ by the Typhoon, with significant coral breakage. Matalyoch was the least affected, likely due to the location of the reef – it was partially protected from the brunt of the Typhoon by the large reef extending from in front of the landing at Asor. This reef is a shallow table with minimal coral cover and is regularly exposed to heavy wave action – protecting Matalyoch to some degree. The majority of coral cover at Matalyoch is deeper and probably out of the direct impact zone of the Typhoon. The areas that are dominated by the brittle, ‘invasive’ (weedy) Montipora coral were heavily damaged, with 30% to 90% of the coral destroyed. However there was widespread evidence of colony regrowth beginning, with small fragments up to entire colonies already re-established. The area known as Lamoor (an important fishing site) was heavily damaged, with very large coral heads removed and reduced to rubble. This is a shallow reef area that connects the lagoon with the outside waters, and is not sheltered by an island. Large branching corals (eg. Isopora, Pocillopora and Heliopora), had been broken, and massive Porites colonies were reduced to rubble. Branching Acropora colonies had been broken. Some showed clear signs of heat stress and bleaching from low tides (possibly associated with the current El Nino event) and, perhaps, abrasion from the coral rubble displaced by the Typhoon. Algae dominated in many areas, and we noted an increase in ‘farmer’ damselfish (Stegastes sp.). We did note that many of the smaller rubble pieces, including small and large fragments of branching corals that were alive, had already ‘reattached’ to the reef table and were growing. Overall, the damage was extensive, but there are clear signs of coral regrowth. We believe that with proper support and management, these reefs show signs of resilience.
MogMog reefs:
MogMog has jurisdiction over diverse reefs. The reefs in front of the island of MogMog as well as Pongeras and Sorghlei were similar to the landing at Asor – there was significant damage to the brittle Montipora. We saw more algae and cyanobacteria in front of MogMog however, suggesting a higher level of eutrophication, less water flow, higher temperatures, or some combination of these. (MogMog historically had the largest human population, although Falalop, with the building of the high school, has now surpassed it.) It could be that the position of MogMog in the northern lagoonal exposure makes it prone to low water movement and higher accumulation of organic materials (this needs to be verified with additional data). We did see some re-growth on some Montipora colonies, and some on small branching Porites colonies.

We also sampled Laam (north western ‘elbow’), Pilelelel (west facing) and Pig (far south). These reefs (and all of the western facing oceanic reefs) showed minimal damage to corals and signs of recovery. Some large branching Isopora and Pocillopora colonies had been broken (some entirely broken off at the base), but many (most) showed signs of regrowth. Even the fragments, which had been deposited in shallower water, were reattaching and re-growing. Fish populations were generally stable when compared with 2014 data. Laam is a site that is similar to Lamoor (Asor), with a more northwesterly exposure, and a wider crest area. It was in good condition overall compared with 2014, in stark contrast with Lamoor. Pilelelel and Pig both had minimal damage to corals and high coral cover. These sites also had visible and often large patches of Crustose Coralline Algae. We did note that the lagoon site (easterly facing) of Pilelelel and both sites on Pig had what appeared to be higher cover of the green Microdictyon alga.

Federai reefs:
Federai manages a very diverse set of reefs. We found equally diverse effects from the Typhoon. The lagoonal side of the main island of Federai showed moderate damage to the brittle Montipora corals. There were rubble fields evident, algal and cyanobacterial mats, but in general not as severe as MogMog and Asor. Federai does show advancing Montipora growth (pre-typhoon), but in general has a higher diversity of branching and massive corals than the lagoon-facing reefs of the other three islands. These branching and massive corals showed far less damage than to the Montipora. The island that appeared the hardest hit near Federai was Fetabul. This is an important fishing area for Federai (and is close to the village site). The lagoon facing reefs of Fetabul showed a high degree of damage with the Montipora having been heavily fragmented, and the branching corals showing signs of near complete breakage in some areas. Large coral heads and parts of the reef structure itself had been uprooted and were lying on the sand. There was evidence of algal and cyanobacterial mats growing on the coral rubble.

The western facing island of Yealil showed the least damage. These reefs had some of the highest coral cover and morphological diversity pre-typhoon, and they remained the highest post-typhoon. Similar to the other reefs, some of the large
branching colonies showed signs of breakage, but Yealil reefs were among the least affected.

*Falalop reefs including the turtle/ Crab islands*”

Falalop, located just outside of the Atoll, has more water movement around it. Although it has the highest population, this water flow may benefit it in some ways. It may remove nutrient runoff more quickly than around lagoonal islands, and currents may keep temperature lower (this needs to be substantiated with data). However, it may also have less access to coral and fish recruitment (we have not collected data on this yet). The south facing reefs in front of the island near the men’s house suffered extensive damage, though not as extensive as Asor and Mog Mog with similar exposures. The Montipora-dominated reefs were heavily fragmented, with significant algal and cyanobacterial mats growing. There was evidence of colony regrowth. The reefs farther to the east and the west of the men’s house, which had a lower cover of Montipora to begin with, also had less damage to corals. There was extensive evidence of damage to the larger branching corals and hydrocorals such as Pocillopora, and some Millopora.

The crab and turtle islands (we sampled Geilob west and Loosiep south) had little evidence of damage (except to some of the larger branching corals), and high percent cover of Crustose Coralline Algae. Fish densities and diversity appeared high at these sites.

Overall, there is clear evidence of damage when compared with pre-typhoon reef status (data are being analyzed now), and anecdotal evidence that the management put in place pre-Typhoon was effective. The communities seem energized and encouraged by the management that has been implemented. They believe it is working (women, men, fishermen, kids, and leaders). They also believe it has brought their leadership and communities together. Our observations echo this, and the fact that some communities were able to open previously closed areas right after the typhoon and gain access to needed resources is a testament to how important management can be in a sometimes unpredictable climate regime. These communities are doing what few others in the world have done – working with a team of scientists to effectively and rapidly implement management on their reefs. They have shown leadership, integrity, and wisdom in the steps they are taking, and their work should serve as a global model.

It is important that support to the FSM communities include support directly to the Outer Islands, and specifically for marine management. They do not need to be told what plans to implement, but rather supported with information and resources to implement the plans they develop. They need assistance to document the effect of the plans, and to implement innovative restoration and resource enhancement projects such as FADs, fuel funds and others. These communities would also benefit from support to better dispose of organic waste (which can be especially harmful to reefs), and solid waste disposal. If reconstruction and recovery programs, climate adaptation programs, and other sources of support take into account these issues, as
well as recovery of the reefs, the long-term sustainability of these communities can be realized, despite the devastating effects of a typhoon such as Maysak.

In addition to reef surveys, our student teams worked together on a number of projects and creative community building including:

- Making awesome music together (see the Facebook page and blog for some songs!)
- Data entry
- Working on free-diving skills
- Teaching each other about culture and participating in activities like: hunting and fishing, making coconut oil, preparing and cooking fish and crabs, and gardening (rebuilding and replanting gardens destroyed by the typhoon).
- Beach and island cleanups

Cooking and gardening on Asor. We visited each island: Federai, Asor, Mog Mog and Falalop for reef surveys and to meet with each community. Youth teams participated in surveys as well as clean up, gardening and other activities.
Dinner on Geilob – fresh caught and cooked

Community of Asor Island

Community of Federai Island
Additional notes on the Expedition

Ulithi Atoll is reached via Yap using a 10-seat aircraft operated by Pacific Missionary Aviation (which did outstanding relief work since the Typhoon), and flown by pilot Amos Collins. First impressions of the island from the air were of great damage.

On the ground, all large structures were damaged, including coconut trees, and tin roof pieces were either in the ocean or in the forest in an unusable state.

Falalop has a reverse osmosis system that provided some drinking water, however running (mostly brackish) water was of limited availability, and so was electricity in general. Nevertheless, local people welcomed the expedition members with open arms and incredible generosity. Expedition members stayed most of the time in
Falalop, and also spent one night in Federai (in the dispensary, which was not damaged by the Typhoon) and one night on the turtle island of Geilop (sleeping on the beach), where they helped to read turtle tags and assess the reefs.

Overall, this was an exceptionally productive expedition, especially given the difficult working circumstances.

**Follow-up**

On the way back home, expedition members met with the Ulithi communities in Yap, and in Kona, Hawaii, to describe their impressions and preliminary results.

![Image of expedition members and local community members.](image.jpg)

*Yap outer islands and Ulithi community in Kona, Hawaii, July 4th, 2015.*

Thanks to all of you for helping to make this an awesome experience and a VERY productive sampling period! We look forward to sharing our results with the communities and others who may use them to advance marine resource management in the Outer Islands.

**Sa Hachig chig!!**