SOLOMON ISLANDS

FIELD REPORT 17

October 26, 2014 - November 24, 2014

Author: Andrew W. Bruckner

Khaled bin Sultan
Living Oceans
Foundation

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Khaled bin Sultan Living Oceans Foundation
130 Severn Avenue
Annapolis, MD, 21403, USA
301 577 1288
Executive Director Philip G. Renaud.
Andrew W. Bruckner, Chief Scientist

Images by Andrew Bruckner, Ken Marks and Joao Monteiro, unless noted.
Maps completed by Alexandra Dempsey.

Executive Summary

Between October 26, 2014 and November 24, 2014, the Khaled bin Sultan Living Oceans Foundation conducted a coral reef research, outreach and education mission to map and characterize the shallow marine habitats and assess the status of coral reefs and coral reef species in the Solomon Islands.

The mission was undertaken in partnership with scientists from University of Queensland, James Cook University, University of the Philippines, University of the Azores, National Museum of Marine Biology and Aquarium Taiwan, University of Hawaii-Manoa, Atlantic and Gulf Reef Assessment program, the Solomon Islands Ministry of Fisheries and Marine Resources, Catlin Seaview Survey, and OceansWatch. The research mission focused on coral reefs in five regions: New Georgia Islands (around Munda Village), Gizo Island, Arnavon Islands (Sikopo, Kerehikapa, and Malakobi Islands), Marovo and Nono Lagoon, and Santa Cruz Islands (Vanikoro, Utupua, Reef Islands and Tinakula).

Scientific Objectives

The main objectives of the scientific research were to 1) map and characterize the shallow reef marine habitats; and 2) conduct assessments and research to understand the current status, health and resilience of Solomon Islands coral reefs. WorldView-2 multispectral satellite imagery was acquired for each area and extensive bathymetry and drop camera surveys were conducted to classify depths and habitat types. This effort included a) an evaluation of existing habitat classes and possible revision and/or addition of habitat classes to correspond to other classification schemes used in the Pacific; b) mapping of the spatial distribution and extent of each habitat type; and c) determination of the bathymetry from the shoreline to 25 m depth. Coral reef surveys focused on 5-30 m depth, in both fore reef and lagoonal sites. In each location, replicate reef fish assessments (4 m X 30 m transects), coral assessments (1 m X 10 m belt transects), photographic transects (1 m X 10 m), and benthic assessments (10 m point intercept surveys) were completed.

The coral reef assessments were undertaken to acquire information on: a) the current status of coral reefs in each of five regions; b) detailed information of zonation patterns and population dynamics of coral taxa, reef fishes, algal functional groups, motile invertebrates, and other organisms inhabiting the coral reefs and associated habitats; and c) the health and resilience of these communities. An evaluation of the status of commercially important reef fishes and invertebrates, including groupers, sea cucumbers, mollusks and crustaceans was also undertaken. Specific research focused on stressors associated with climate change and resilience of corals to these stressors, with emphasis on coral health, coral diseases, coral symbionts, and ocean acidification.

We also conducted research on the effects of temperature and changing ocean chemistry on coral health, coral disease, and coral growth. A total of 96 cores were collected from *Porites lobata* to characterize differences in growth rates between islands. 476 samples were removed from 6 species of *Pocillopora* to evaluate variations in symbiont density and type (clade) between islands, reefs and depths. In addition, 171 *Pocillopora damicornis* and 221 *Seriatopora* spp. samples were collected to assess health and biomarker expression. Six sites were revisited at night to collect crown of thorns sea stars and to conduct measurements of photosynthetic efficiency of corals examined during daylight using a PAM fluorimeter. Detailed PAM measurements were also made at one location in Vanikoro to evaluate differences in fluorescence of bleached and healthy *Pocillopora damicornis* tissue.

Outreach Partner: Catlin Seaview Survey

Throughout the first half of the research mission our partners, the Catlin Seaview Survey, used their custom panoramic camera system to document up to 6km of reef per day. This is part of an ongoing research project whose primary aim is to measure coral reef habitat diversity across the span of the tropics, and to use this information to understand how coral ecosystems may be changing across the world due to human pressures. They use a unique propeller-driven, high definition, 360 degree panoramic camera system, to create interactive images of reefs in a way very similar to Google Street View. The downward-facing portions of these panoramic images are also processed for community composition and benthic cover/diversity. These extended linear transects (up to 2 km long per dive) can illustrate changes in benthic cover across transition points, and also can provide a greater amount of information with which to describe benthic cover, compared to static diving techniques.

These images collected by University of Queensland researchers from the field are also processed to give a near-realistic diving experience for anyone with access to the web, as the images can be manipulated by the viewer (looking up or down, and moving from one location to another). This new media format has brought students of all levels, divers who want to see what it looks like in places they have not visited, and non-divers alike into the virtual ocean, with the goal of inspiring greater interest in the beauty, condition, and conservation issues of coral reefs.

Education Partner: Oceans Watch

During the research mission, the Education Department, working in conjunction with OceansWatch, a New Zealand registered NGO that has been working in the South Pacific for the past 7 years, provided land-based education seminars throughout the Solomon Islands at primary and secondary schools as well as at communities. During the mission, schools were either taking exams or on holiday break, so the majority of the seminars were provided to communities where men, women, and children attended the talks. Overall, the Foundation conducted 4 school and 25 community seminars and 4 ship tours reaching a total of 2,638 people.

Research Sites

Over the 30 days, the science team surveyed 74 reefs in Isabel Province, Western Province and Temotu Province. In total, assessments and research were undertaken off Munda (3 sites), Arnavon Islands (12 sites), Gizo (6 sites), Marovo and Nono Lagoon (9 sites), Vanikoro (12 sites), Utupua (11 sites), Reef Islands (16 sites) and Tinakula (3 sites). In total, scientists conducted a total of 828 reef fish transects, 423 benthic point count surveys, 280 coral belt transect surveys and 857 photo-transects from 5-30 m depth on 69 reefs. Qualitative observations were also recorded on five additional shallow sites (by snorkeling) in Temotu Province and a long-distance assessment of Tinakula was undertaken using DPVs.

Team

Name	Organization	Role
Andrew Bruckner, Ph.D.	Living Oceans Foundation (KSLOF)	Chief Scientist, coral assessments
Alex Dempsey, M.S.	Living Oceans Foundation	Coral reef ecologist
Amy Heemsoth	Living Oceans Foundation	Education Director
Steve Saul, Ph.D.	Nova Southeastern University (NCRI)	KSLOF Post Doc Fellow, Habitat mapping
Robert Gardiner	Nova Southeastern University (NCRI)	Ph.D. candidate, Habitat mapping
Grace Frank	James Cook University	Coral assessments
Ken Marks	Atlantic and Gulf Rapid Reef Assessment	Coral reef phototransects
Badi Samaniego	University of Philippines	KSLOF Fellow, fish surveys
Joao Monteiro, Ph.D.	University of Azores	KSLOF Fellow, coral symbionts
Anderson Mayfield, Ph.D.	National Museum of Marine Biology and Aquarium, Taiwan	KSLOF Fellow, Post Doc, coral health
Kristin Stolberg	University of Queensland	Benthic assessments
Renee Carlton	University of Miami/NOAA	Ocean acidification
Stefan Andrews	Rolex Fellow	Reef Fish surveys
Georgia Coward	OceansWatch	Coral reef education
Garrett Johnson	Hawaii Institute of Marine Biology	Fish assessments
Kristen Brown	University of Queensland	Catlin Seaview Survey—Shallow Reef Team
Peter Dalton	University of Queensland	Catlin Seaview Survey—Field Technical Officer
Ulricke Siebick	University of Queensland	Catlin Seaview Survey—Fish Team
Benjamin Neal	University of Queensland	Catlin Seaview Survey—Shallow Reef Team
Ivory Akao	MFMR, Solomon Islands Government	Coordination
Wade Fairley		Camera

Fig. 1. Measuring the fluorescence of a Pocillopora damicornis colony using a PAM fluorimeter.

The main challenges encountered were associated with 1) allotted time for the research; 2) rough sea conditions during the second half of the mission; and 3) securing permissions from local communities, elders and Chiefs to anchor our research vessel and survey specific reef locations. Because the research mission was shortened from the original proposal submitted for April, 2014, an entire region was omitted (Sikaiana Islands). In addition, heavy wave action, surge and strong winds limited surveys on fore reef communities on windward (east) sides of the Vanikoro and Utupua. Efforts were made to contact relevant local communities and individuals prior to embarking on the research, and during the mission to implement a coral reef education and secure access to research sites. Considerable assistance in communications was provided by the Ministry of Fisheries, including our ship-based coordinator and local fisheries officers, and by OceansWatch and three village leaders for Vanikoro, Utupua and Reef Islands.

General Findings

Corals

Coral communities in general were mostly in good condition, with some exceptions at exposed sites, sites impacted by recent storms, reefs with crown-of-thorns outbreaks, and sites with high cover and biomass of macroalgae and cyanobacteria. Unique assemblages of corals were often documented on individual reefs. Dominant species differed among reefs and variations in species and growth forms were often found at different depths and habitat types, between lagoonal and fore reef environments, and between windward and leeward locations. A number of reefs had single species assemblages that formed unusually large (10-50 m diameter or more) stands, with one species coalescing into a coral thicket of a different species.

While some reefs had flourishing coral communities that extended well below our 30 m survey depth, it was more typical to have a healthy community with high coral cover in shallow water (4-12 m depth), unusually thick mats of cyanobacteria, calcareous green coralline algae (*Halimeda*) and fleshy seaweed (macroalgae) in deeper water, and a rapid decline in living coral below 12 m. Each island or region also had both "good" and "poor" sites in terms of live coral cover, high-relief structure and healthy coral communities. "Good" sites included shallow areas dominated by branching, digitate and tabular acroporids and large stands of foliaceous and plating corals in deeper water. A number of sites had high amount of old mortality, recent partial mortality from disease, snail predation, overgrowth by sponges and algae, evidence of past storm damage and extensive bioerosion. Voracious crown of thorns starfish were seen in most locations, but severe localized outbreaks were only found on three reefs in the Reef Islands, one in Munda, and one in Gizo.

On all fore reef locations the shallow communities (4-12 m) generally had very high coral cover with large old-growth colonies and high diversity. The reef framework consisted of large spur and groove structures with 3-5 m relief between the top of the spur and the base of the channel. The shallow reef crest transitioned from a scoured hardground with CCA and turf algae and few corals above 2-3 m depth (e.g. the reef flat) to a flourishing "coral garden" at the edge of the crest near the reef slope. The sides of shallow spurs were densely colonized by plating and encrusting corals, while the tops had a high cover community consisting of table acroporids, *Isopora* plates and branches, thickly-branched *Acropora robusta* colonies, foliaceous sheets of *Turbinaria*, large plates and encrustations of *Montipora*, large massive *Porites lobata*, *Diploastrea* and *Platygyra* colonies, and a high diversity of other branching and massive species. On the reef slope, starting from the base of the spurs and extending to 30-35 m, the reef framework was much less consolidated. In general, corals occurred on small mounds and ridges, up to 2-3 m diameter, with areas of sand, rubble and dense patches of *Halimeda* algae. Deeper reef communities often had 60-80% cover of *Halimeda,* with cyanobacteria and large clumps of *Caulerpa*. Coral cover quickly dropped off below 12 m, with no more than 2-3% cover at 20-30 m.

Fig. 2. An unusually large monospecific assemblage of Montipora. Scale bar is 1 m.

Fish

Reef fish communities were characterized by a very high number of species. Over 587 species were recorded (final numbers still being compiled). Although the diversity was high, there were few sightings of top predators such as sharks and groupers; those that were seen were often very small and only a few were 50 cm or larger. The dominant predators were snappers, but they occurred in low abundances and biomass with exception of a few locations. Most herbivores were also small compared to surveys undertaken in other Pacific countries examined during the Global Reef Expedition and dense schools of parrotfish and surgeonfish were uncommon. Reefs were typically dominated by small-bodied fish such as damselfish, butterflyfish and wrasses and many of the larger species were found only as juveniles.

There were a few exceptions to these general trends. Marine protected areas in Arnavon Islands had large populations of schooling herbivores and a high fish biomass of snappers, breams and herbivorous surgeonfish and parrotfishes. The largest population of pelagic predators (e.g. jacks and barracudas), as well as snappers, groupers and sharks were seen on the outer reefs off Vanikoro, Utupua and Reef Islands, Some of these areas also had large bumphead parrotfish, Napoleon Wrasse and schooling herbivores. Fish species diversity was generally higher at Utupua, Vanikoro, Reef Islands, Tinakula islands compared to those surveyed in Gizo, Munda, Arnavon and Marovo. More sightings of large predators such as grey reef sharks (*Carcharhinus amblyrhynchos*), and whitetip reef sharks (*Triaenodon obesus*) although total numbers per reef of shark sitings were still very low (one or two per reef). Predatory reef fish such as groupers (*Plectropomus laevis*, *P. areolatus* and *P. leopardus*), and snappers (*Lutjanus bohar*) were relatively more abundant and of larger sizes (>50cm). There were several sightings of very large schools of herbivores such as parrotfishes (*Hipposcarus longiceps*, *Scarus altipinnis*, *Chlorurus microrhinos* and *Bolbometotom muricatum*), and surgeonfish (*Acanthurus grammoptilus*, *A. lineatus* and *Ctenochaetus striatus*). Schools of large planktivorous fish were also often encountered (snappers *Macolor niger* and *M. macularis*; surgeonfish *Naso hexacanthus*).

Fig. 3. Large schools of jacks were seen on a small number of reefs in Temotu Province.

Munda Village

- Reef had a well-developed *Porites lobata* framework with colonies of intermediate size, many of which had previous partial mortality and recent mortality from crown of thorns starfish. Shallow parts of the reef had some extensive branching *Acropora* communities and deeper areas had some large stands of foliaceous corals, especially *Turbinaria*.
- High cover of turf algae and cyanobacteria were found in many locations, especially on dead corals
- Despite relatively low relief and only moderate physical complexity, there was very high diversity, and high abundance of target fish such as surgeonfish.

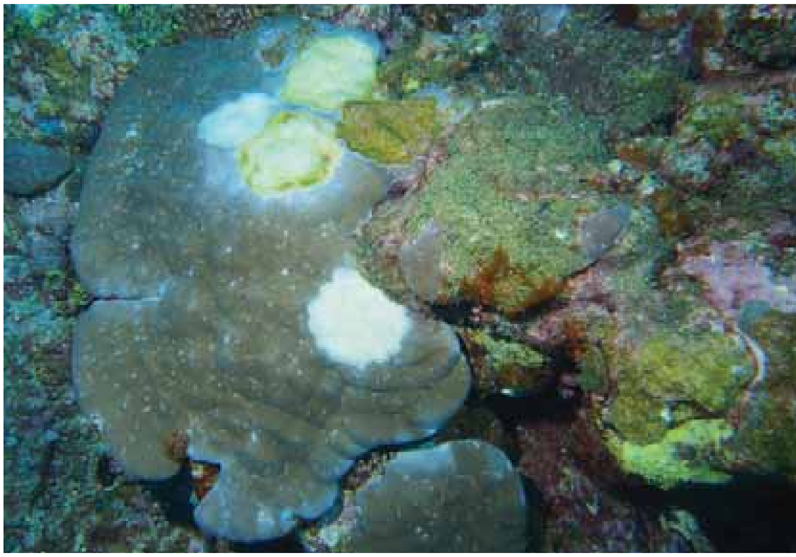


Fig. 4. A medium-sized colony of Porites lobata on the fore reef off Munda village. This (and many other corals) colony had prominent, recent lesions from crown of thorns sea stars.

Fig. 5. Shallow Acropora dominated fore reef community near Gizo.

Gizo Island

- Many of the outer reef systems on the south had fairly low relief and gentle slope. The reef crest, reef flat and submerged reef systems had very low relief spurs and channels that were characterized by a scoured, barren hardground, with a dominance of low-lying thick branched *Isopora* and *Acropora* and submassive and encrusting favid and *Porites* corals.
- More protected reef systems had well developed shallow *Acropora* habitat and deeper areas dominated by large mounds and overlapping sheets of plating and foliaceous corals. Deeper areas had very high cover of thick mats of *Halimeda* with cyanobacteria and large mats of soft corals and leather corals.
- Lower fish abundance and biomass than reefs around Munda. Fish were mostly small and dominated by surgeonfish *Ctenochaetus striatus* and *Acanthurus lineatus*.

Sikopo and Kerehikapa Islands, Arnavon Islands

- Reefs of Sikopo and Kerehikapa had some of the largest stands of foliaceous corals seen in the Solomon Islands at intermediate and deeper depths (15-30 m), with some very large staghorn coral thickets in shallow water and extensive coral bommies constructed from *Porites lobata*. Bioerosion of massive corals was very noticeable.
- Very good fish diversity. High numbers of schooling surgeonfish *Naso hexacanthus*, snapper *Macolor niger* and damselfish *Chromis ternatensis*. However, large predatory fish were still very few.

Fig. 6. An unusually high number of boring organisms, such as Christmas tree worms (Spirobranchus) shown here on a Porites lobata colony were seen on reefs near Kerehikapa Islands.

Malakobi Island

- Windward reef environments were characterized by an elongate system of shallow, very low relief, ridges with numerous shallow spur-like hardground structures extending between the islands. These appear to be exposed to strong waves and currents as the corals were all very low-relief encrusting, thick branched and submassive growth forms.

- Better coral development was found in leeward sides and at the edges of the islands. The top surfaces at 6-10 m tend to be dominated by low-relief Isopora colonies, small staghorn corals, thick branched *Acropora robusta*, digitate acroporids and small to medium table acroporids, intermixed with small to medium (20-50 cm) favids, *Astreopora*, *Porites lobata* and small *Pocillopora*, *Stylophora* and *Seriatopora*. Reef slopes, especially deeper have very high cover of thick *Halimeda* and *Caulerpa* in places, with a lot of cyanobacteria and areas dominated by soft corals.

- There were noticeably fewer fish at deep transects, and more fish at shallow transects in reef crest environments. In general, these reefs had low diversity compared to other areas in the Arnavon islands. One exception was SOMA 21, which had very high diversity and the higher fish biomass of predators such as snappers *Lutjanus gibbus*, *Lutjanus bohar*, breams *Monotaxis grandoculis* and herbivorous surgeonfish and parrotfishes than seen elsewhere in the Arnavon Islands.

Fig. 7. High cover of Sarcophyton was seen on many deeper reef locations off Malakobi Island.

Nono Lagoon

- Sites inside the lagoon had very low visibility and generally poor coral communities with the best development extending from the edge of the reef crest to 5-8 m, and less coral deeper. Reefs on the back side of the barrier had large areas of rubble and low coral cover.

- Fore reef locations were mostly very steep walls with a shallow reef terrace and crest and a near vertical drop-off. Coral cover on the wall was generally low, except on horizontal ledges.

- Very good diversity of fish. High counts and biomass of herbivores *Acanthurus lineatus* and *Ctenochaetus striatus*; and planktivores *Caesio caerulaurea* and *Caesio lunaris* at the edge of reef crest. At one site a dense aggregation of the surgeonfish *Ctenochaetus striatus* was spawning.

Fig. 8. Vertical wall on the fore reef surrounding Nono Lagoon. The left side is a distance showing the high numbers of small planktivorous fishes, especially Anthias spp.. The right side is a close-up of the wall with few reef building corals and high cover crustose coralline algae, turf algae and Tubastrea corals.

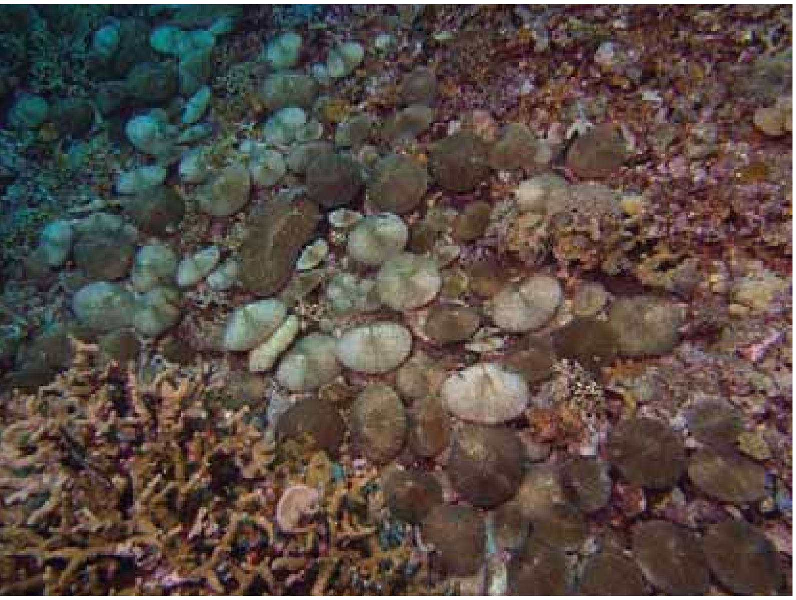


Fig. 9. A large pile of free-living fungid corals on the fore reef outside Marovo Lagoon.

Marovo Fore Reef

- The fore reef locations we examined had a very wide, gently sloping fore reef with high coral cover dominated by large monospecific assemblages of branching acroporids, *Lobophyllia*, *foliaceous Montipora*, *Turbinaria*, *Echinopora* and other species, with large aggregations of free-living Fungia and other species between these assemblages. The fore reef dropped near vertically at 10-12 m depth; coral cover quickly diminished on the wall.

- Poor fish diversity and abundance, especially at the wall. Even parrotfish and snappers were relatively small compared to other sites.

Fig. 10. The fore reef off the south side of Utupua had a well-developed spur and groove zone with high coral cover.

Bully Point

- Extending 10-20 m from shore was a fringing reef with high cover and moderate diversity (dominated by acroporids) from 2-5 m. Coral cover declined rapidly to <1% in deeper water, with scattered corals on boulders. The bottom had a lot of organic matter on sand.
- No fish in deep locations, except for a few goby species in high numbers. Good fish diversity at shallows areas with higher complexity of hard substrate. There was a high concentration of juveniles at this site (snapper *Lujanus gibbus*, threadfin bream *Pentapodus* sp., wrasses, and damselfish).

Utupua Island

- Fore reef locations off the south had a prominent spur and groove system with long ridges and mounds of reef habitat and a gentle slope. The spurs were often 3-8 m taller than the surrounding channels. There was a very wide low-relief habitat between the shallow spur system and deeper reef community in some areas. There was also a slight build-up at the edge of the fore reef slope from 15-25 m depth, then a steep drop-off on the seaward side. Shallow communities often had large massive corals (especially *Platygyra* and *Favia stelligera*) intermixed with table acroporids and branching *Acropora*. Deeper areas had more plating and foliaceous species. Low-relief areas and dead skeletons often had high cover of turf algae and cyanobacteria and a high number of damselfish algal lawns.
- Lagoonal reefs had patches of coral in shallow water and very high cover of *Halimeda* and cyanobacteria.
- Very high diversity of fish. In some sites fish were few on the deeper sections of the reef and more abundant in shallow areas with high concentrations of planktivores (fusiliers *Pterocaesio tile* and *Caesio lunaris*; snapper *Macolor niger*; damselfish *ternatensis*, *Chromis xanthura*, *C. amboinensis*, and *C. atripes*). High biomass of fish and large schools were also observed at some sites (i.e. Sites 40, 41 and 42: jacks *Caranx sexfasciatus*; snappers *M. niger*, *Lutjanus bohar* and *L. gibbus*; parrotfish *Chlorurus microrhinos*, *Hipposcarus longiceps*; surgeonfish *Acanthurus grammoptilus*, and fusiliers).

Fig. 11. Lethal orange disease was commonly observed on crustose coralline algae in the fore reef of Vanikoro.

Vanikoro Island

- Fore reefs on the south side have extensive build-ups of *Halimeda* and *Caulerpa*, most of which is colonized by cyanobacteria. Reef substrates are also thickly colonized by long filamentous cyanobacterial mats. Dominant corals on the fore reef are *Porites lobata*, which form large massive corals that are low-relief plate-like, generally 20-40 cm thick; table acroporids, many which are 1.5 m diameter; plates of *Montipora* and *Porites lichen*; and foliose sheets of *Turbinaria* and *Pachyseris*. Massive faviids were common at 5-10 m depth, including large *Favia stelligera*, *Goniastrea*, *Favites*, *Platygyra* and other species. From 2-5% of the table acroporids were completely dead and approximately 1% have white syndrome.
- The spur and groove habitats as well as lagoonal reefs surveyed showed moderate to low abundance of fish compared to Utupua. Very often, there were high fish densities on the shallow sections of the reef. Diversity of fish remained high and was dominated by small fish such as damselfishes. Many juvenile fish were observed at Site 50, and among them were several Napoleon wrasses *Cheilinus undulatus*.

Reef Islands

- Coral communities varied in condition with some fore reef sites having very high cover in shallow water, deeper areas dominated by large *Porites lobata* and patches of foliaceous corals, while other sites had very low cover and extensive areas of dead skeletons. A number of reefs surrounding the small islands on the perimeter (north and east sides) had well developed *Acropora* communities from 3-10 m depth with very large old-growth table acroporids and a framework constructed of large *Porites lobata* stands. Lagoonal reefs generally had patchy coral cover, except for the shallow fringing reefs and a few deep locatiuons (25-30 m). Large mats of *Caulerpa*, *Halimeda* and cyanobacteria were common. A shallow lagoonal reef in the northeast contained an extensive (100s of meters) *Acropora* and *Isopora* dominated community with 60-80% live cover. Several reefs had evidence of past COTS outbreaks and active outbreaks were recorded in three locations.

- Some of the highest fish diversity were recorded at Reef Islands. There were very dense concentrations of small fish (*Chromis* spp.). In many sites good numbers of Napoleon wrasse *Cheilinus undulatus*, surgeonfish *Acanthurus grammoptilus*, snapper *Macolor niger*, and drums *Kyphosus cinerascens* were recorded. Very high biomass and abundance of herbivores were recorded at Site 59 (school bumphead parrotfish *B. muricatum* (15 individuals of c. 100cm length), a school of over 100 parrotfish *Hipposcarus longiceps* and *Clorurus microrhinos*; and surgeonfish *A. grammoptilus*. Some of the high concentrations of groupers were also observed at these islands (*Plectropomus areolatus* some 80cm big).

Fig. 12. Shallow fore reef communities of the Reef Islands often had very large old growth assemblages of table acroporids.

Fig. 13. Underwater scene at Tinakula showing the basaltic formations.

Tinakula Island

- Coral communities on Tinakula varied from well developed, high coral cover areas in areas distant from recent lava flows to uncolonized basaltic substrates closest to recent lava flows. The bottom consisted of some black sand slopes, large boulders in shallow water, cobble, and vertical sloping pinnacles. Recruitment was very high, with boulders covered in small recruits (10-50/m2) and medium sized corals, depending on the amount of time since the rock was deposited. On older basaltic surfaces there was extensive Acropora-dominated areas in shallow water and deeper areas with massive *Lobophyllia*, plating and foliaceous *Montipora* and *Turbinaria*, *Porites* and many other species. Cover exceeded 50% in some areas, while algal cover was exceedingly low.

- Tinakula Island had the least variety and number of herbivores. Because of its very unique habitat, several more species of fish were recorded at this site (wrasse, hawkfish and cardinalfish). Surprisingly, there were also a few large groupers (*Plectropomus laevis*), and dogtooth tuna (*Gymnosarda unicolor*), and a school of over 200 snappers *Macolor niger*.

Fig. 14. Map of the Solomon Islands showing the five island areas of focus.

Methods

Coral reef surveys, research and habitat mapping was conducted in five regions of the Solomon Islands (Fig. 14), with work focused on New Georgia Islands (around Munda Village), Gizo Island, Arnavon Islands (Sikopo, Kerehikapa, and Malakobi Islands), Marovo Lagoon, and Santa Cruz Islands (Vanikoro, Utupua, Reef Islands and Tinakula).

Habitat Mapping and Groundtruthing:

Using multispectral satellite imagery obtained from DigitalGlobe WorldView-2 satellite, high resolution bathymetric maps and habitat maps will be created for shallow coral communities. Groundtruthing efforts necessary to develop these maps focus on continuous bathymetry measures, drop camera analysis, characterization of sediment and hard substrates and habitat features using acoustic sub-bottom profiling equipment (Stratabox and Hydrobox) and fine scale photo-transect surveys.

A. Satellite imagery

A total of 3089 sq km of WorldView 2 (8 band) satellite imagery was acquired for this project (Table 2). The satellite images had a spatial resolution of 2-m by 2-m (i.e., each pixel covers a 4-m2 area) enabling real-time navigate in the field to locate features of interest and to avoid dangerous features (e.g., emergent reefs). In order to navigate, the team used the scenes in conjunction with a differential GPS device (dGPS). The imagery is currently being used in conjunction with ground truth data to create bathymetric and benthic habitat maps.

B. Benthic Video

An underwater video camera attached to a cable, called a drop-cam, was used to gather video on the benthic composition at each survey site. At each point, the drop-cam was deployed from the survey boat and flown close to the sea floor as it recorded video for 15 to 60 seconds. During this time, the laptop operator watched the video in real-time and guided the drop-camp operator to raise or lower the camera to prevent contact with the substrate and damage or injury to marine life. The video was recorded on a ruggedized laptop, and the geographic position, time, date, boat heading, and boat speed were burned into the video. Drop-cam deployment was limited to depths above 40 m due to the limited length of the tether cable (50 m). The acquired videos will be used to create the benthic habitat maps by providing the necessary information for developing the habitat classification scheme and training of classification models.

C. Acoustic depth soundings

Depth soundings were gathered along transects between survey sites using Hydrobox, a single-beam acoustic transducer, developed by Syqwest. The instrument emits 3 pings per second. Depths were estimated based on the time the return-pulse's reaches the sounder's head. Geopositional data were simultaneously acquired by the dGPS unit. The estimated depth values and their geographic location were recorded in the ruggedized laptop. The soundings were used to train a water-depth derivation model, which is based on the spectral attenuation of light in the water column. The final topographic map will have the same spatial resolution as the satellite imagery.

General Approach of SCUBA Assessments:

A. Fish Assessments

For fish, abundance and size structure were collected for over 400 species of fishes (Appendix 1), targeting species that have a major functional role on reefs or are major fisheries targets. Reef fishes were assessed along 4 m X 30 m belt transects. A T square marked in 5 cm increments was used to gauge fish size. A minimum of 6 transects is conducted by each "fish" diver per site. A roving survey was also completed to assess the total diversity and relative abundance (rare, common, abundant) of reef fishes at each site. Surveys were performed at shallow (3-8 m depth) and mid-depth (9-15 m depth) locations.

B. Benthic cover

Cover of major functional groups (corals identified to genus, sponges, other invertebrates, and six groups of algae including macroalgae, crustose coralline algae, erect coralline algae, fine turfs, turf algae with sediment and cyanobacteria) and substrate type (hardground, sand, mud, rubble, recently dead coral, bleached coral, live coral) were assessed along 10 m transects using either recorded observations and/or photographic assessments. Recorded observations involved a point intercept method, whereas the organism and substrate was identified every 10 cm along a 10 m transects (total 100 points/transect)(Fig. 15), with a minimum of six transects examined per location/depth.

Fig. 15. A scientist conducting a point intercept survey to characterize benthic coverage.

C. Photographic assessment

A 10 m long transect tape was extended along depth contours at 20, 15, 10 and 5 m depth. Continuous digital still photographs were taken from of the reef substrate from a height of approximately 0.6-0.75 meters above the substrate, using a one meter bar divided into 5 cm increments placed perpendicular to the transect tape as a scale bar. Approximately 20 photographs were taken per transect to allow for overlap between adjacent images with two photo transects (each 10 m in length) per depth. Images were downloaded onto a computer, and benthic community composition, coral cover and cover of other organisms and substrate type, the size (planar surface area) of corals are currently being assessed. Cover is determined by recording the benthic attribute located directly below random points (30-50 points per photograph), using Coral Point Count (CPCE) software developed by the National Coral Reef Institute (NCRI). This software also allows you to trace the outline of individual corals to determine their planar surface area.

D. Coral assessments

A combination of quantitative methods, including belt transects, point intercept transects, radial plots and quadrats were used to assess corals, fish and other benthic organisms. Five measures were recorded for corals: 1) benthic cover (point intercept, see above); 2) coral diversity and abundance (by genus, except certain common species); 3) coral size class distributions; 4) recruitment; and 5) coral condition. Additional information was collected on causes of recent mortality, including signs of coral disease and predation. Assessment of corals smaller than 4 cm was done using a minimum of five 0.25 m2 quadrats per transect, with each quadrat located at fixed, predetermined intervals (e.g. 2, 4, 6, 8, 10 m), alternating between right and left side of the transect. Recruits were identified in both point intercept surveys and belt transects. Recruits were divided into two categories: corals up to 2 cm diameter and larger corals, 2-3.9 cm diameter.

Coral population structure and condition is assessed within belt transects (each 10 m X 1), with a minimum of two transects done per depth. Each coral, 4 cm or larger was identified (to genus at minimum) and its growth form is recorded Visual estimates of tissue loss is recorded for each colony over 4 cm in diameter using a 1 m bar marked in 1 cm increments for scale. If the coral exhibited tissue loss, estimates of the amount of remaining tissue, percent that recently died and percent that died long ago were made based on the entire colony surface. Tissue loss is categorized as recent mortality (occurring within the last 1-5 days), transitional mortality (filamentous green algae and diatom colonization, 6-30 days) and old mortality (>30 days). For each coral with partial or whole colony mortality, the cause of mortality was identified if possible. The diagnosis included an assessment of the type of disease, extent of bleaching, predation, competition, overgrowth or other cause of mortality. Each coral was first carefully examined to identify cryptic predators. Lesions were initially diagnosed into four categories: recent tissue loss, skeletal damage, color change, and unusual growth patterns; an individual colony could have multiple characteristics (e.g. color change and recent tissue loss). The location (apical, basal, medial) and pattern of tissue loss (linear, annular, focal, multifocal, and coalescing) was recorded and when possible a field name was assigned.

Motile invertebrates

Large motile invertebrates (urchins, octopus, lobster, large crabs, large gastropods, sea cucumbers). observed were identified and counted along coral belt transects and benthic point intercept surveys. In addition, one diver conducted timed swims at different depths to document the species diversity and abundance of sea cucumbers at each site assessed. This assessment included a documentation of the type of habitat occupied by these organisms.

Fig. 16. Very few lobsters were recorded within survey locations.

Schedule

Day	Date	Location	Notes
Mon-Tue	27-28 Oct	Flights to Honiara	
Tue	28 Oct	5-6 PM Departure Honiara, Transit to New Georgia Islands	13 hour transit
Wed	29 Oct	Munda Village, New Georgia Island	2 hour transit
Thu	30 Oct	Gizo Island	
Fri	31 Oct	Gizo Island	
		Transit to Arnavon Islands	4 hour transit
Sat	1 Nov	Sikopo and Kerehikapa Islands	
Sun	2 Nov	Sikopo and Kerehikapa Islands	
Mon	3 Nov	Malakobi Island and extending Reef	
Tue	4 Nov	Malakobi Island and extending Reef	
Tue	4 Nov	Transit to Marovo Lagoon	4 hour transit
Wed	5 Nov	Marovo Lagoon	
Thu	6 Nov	Marovo Lagoon	
Fri	7 Nov	Marovo Lagoon	
Fri-Sat	7-8 Nov	Transit to Honiara, Change-out Doctor	15 hour transit
Sat	8 Nov	Transit to Santa Cruz	30 hour transit
Sun	9 Nov	Set up, meetings in Lata	Arrive Santa Cruz Islands mid day
Sun	9 Nov	Bully Point	4 hour transit
Mon	10 Nov	Utupua	
Tue	11 Nov	Utupua	
Wed	12 Nov	Utupua	
Thur	13 Nov	Utupua	2.5 hour transit
Fri	14 Nov	Vanikoro	
Sat	15 Nov	Vanikoro	
Sun	16 Nov	Vanikoro	6 hour transit
Mon	17 Nov	Reef Islands	
Tue	18 Nov	Reef Islands	
Wed	19 Nov	Reef Islands	
Thu	20 Nov	Reef Islands	
Fri	21 Nov	Reef Islands	2 hour transit
Sat	22 Nov	Tinakula	
Sat-Sun	22-23 Nov	Overnight transit to Honiara	25 hour transit
Mon	24 Nov	Depart Solomon Islands	

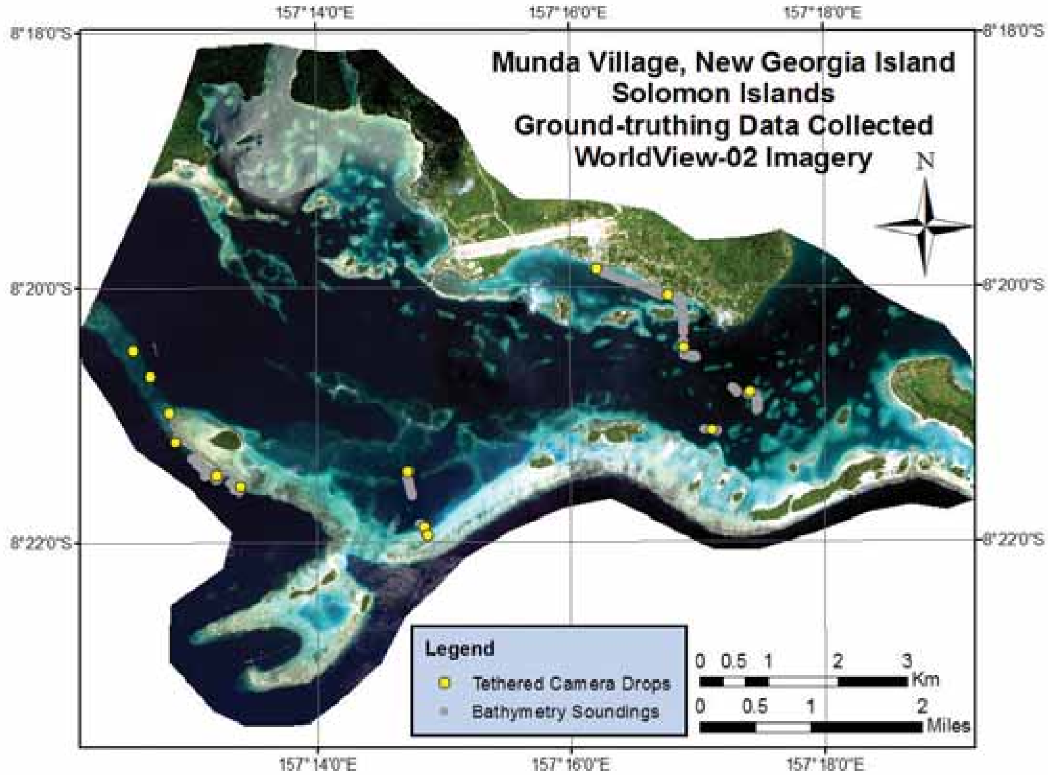
Table 1. Final Schedule for Solomon Islands Coral Reef Research, October-November 2014.

Habitat Mapping

Groundtruthing efforts were concentrated in lagoonal areas and leeward side of fore environments, except during extremely calm weather. In many cases, a track was run close to the reef crest on the outside of the reef, but near vertical surfaces limited the extent of drop camera deployment and bathymetric soundings because the water depth exceeded the resolution of the satellite imagery and standard depths of habitat mapping (25 m). The center of many lagoons presented similar challenges as deep bathymetry soundings ranged from 40-80 m. As expected, outer (fore reef) locations tended to have higher coral cover than lagoonal reefs. However, from a landscape perspective, live coral cover was very patchy with some areas having high cover, others having low cover. One of the complications with the satellite imagery is predicting areas with high cover. Many outside reef systems looked like they had very well developed spur and groove habitats, but these often ended up being very low-relief scoured areas completely covered in *Halimeda* with narrow channels. A summary of the satellite imagery and groundtruthing data collected is shown in table 2 and maps showing the track of the groundtruthing vessel are shown for each island or region on subsequent pages.

Location	Area of Imagery (km2)	Number of Drop Cameras	Number of Sediment Samples	Number of Bathymetry Soundings	Distance Sampled (km)
Munda	71.3	14	0	25,546	12.41
Gizo	187	49	12	286,476	42.61
Arnavon	107	57	4	275,005	48.71
Malakobi	327	88	8	381,572	63.78
Marovo	924	102	12	573,127	80.69
Utupua	352	148	6	606,469	106.56
Vanikoro	596	110	3	483,567	80.45
Reef Islands	499	178	17	788,609	141.38
Tinakula	25.9	14	0	37,890	6.71
TOTAL	**3089**	**760**	**62**	**3,458,261**	**583.29**

Table 2. Summary of the groundtruthing data for the Solomon Islands. The total area of imagery, number of drop cameras, sediment samples, bathymetry soundings and distance sampled are shown for each island.



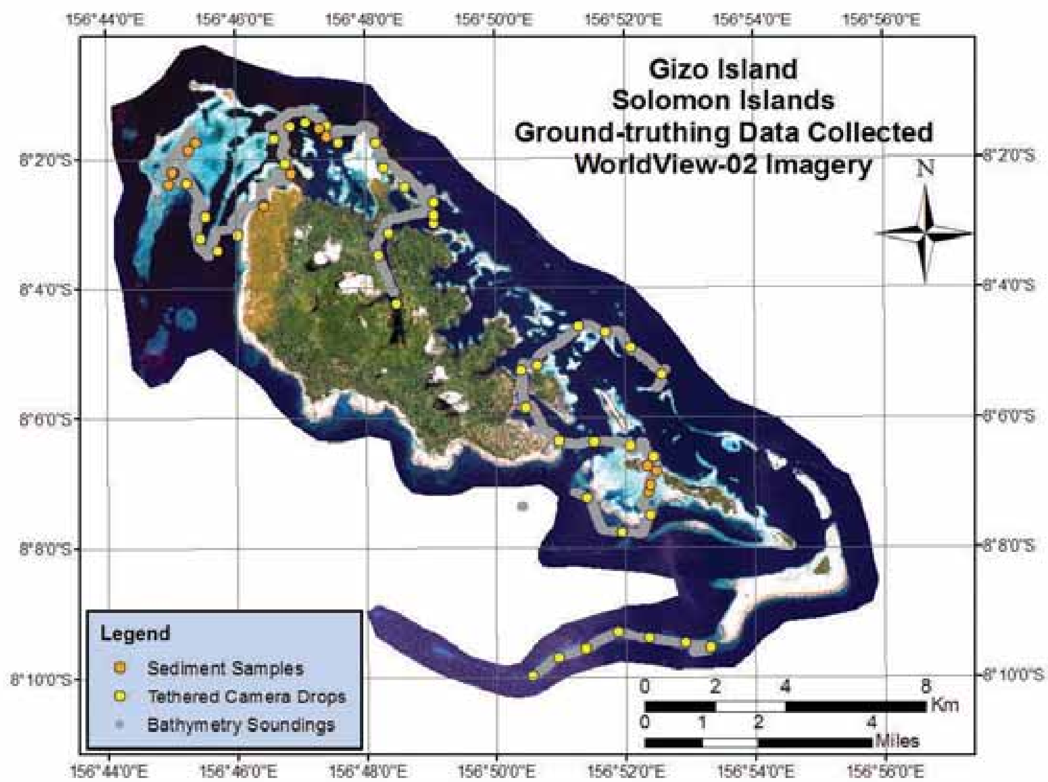
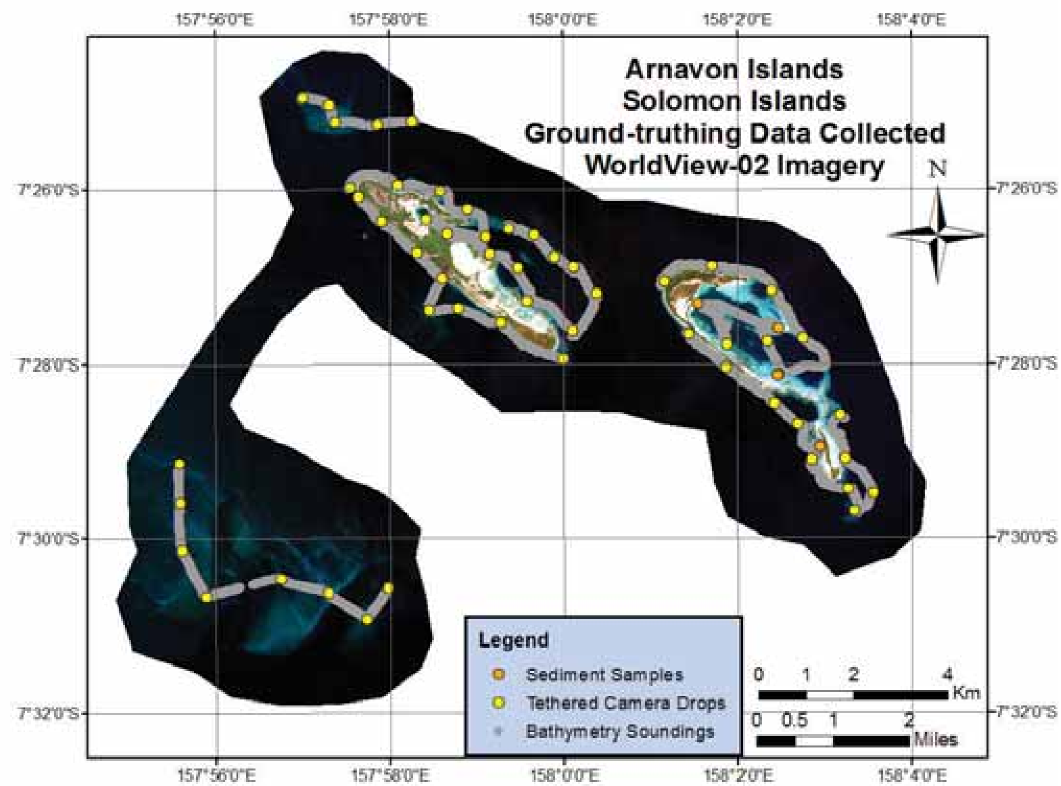


Fig. 17. Track of the research vessel illustrating the locations of bathymetric soundings, drop cameras and sediment samples for Munda and Gizo Island.



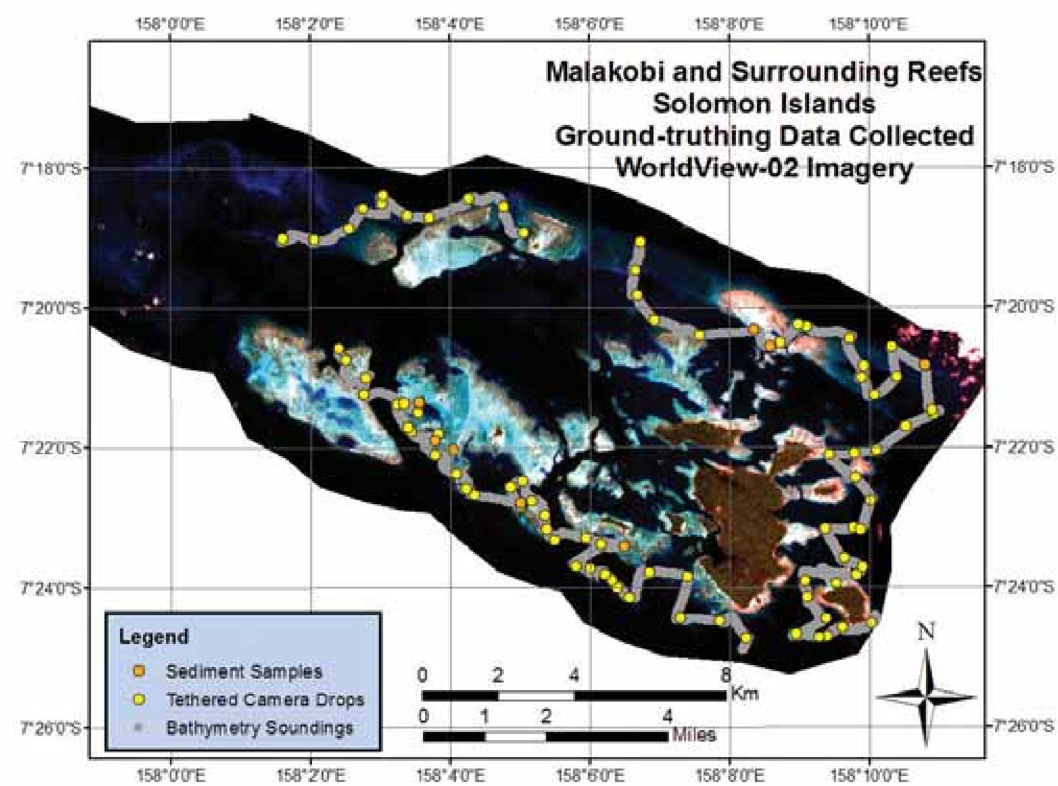


Fig. 18. Track of the research vessel illustrating the locations of bathymetric soundings, drop cameras and sediment samples for Sikopo, Kerehikapa and Malakobi.

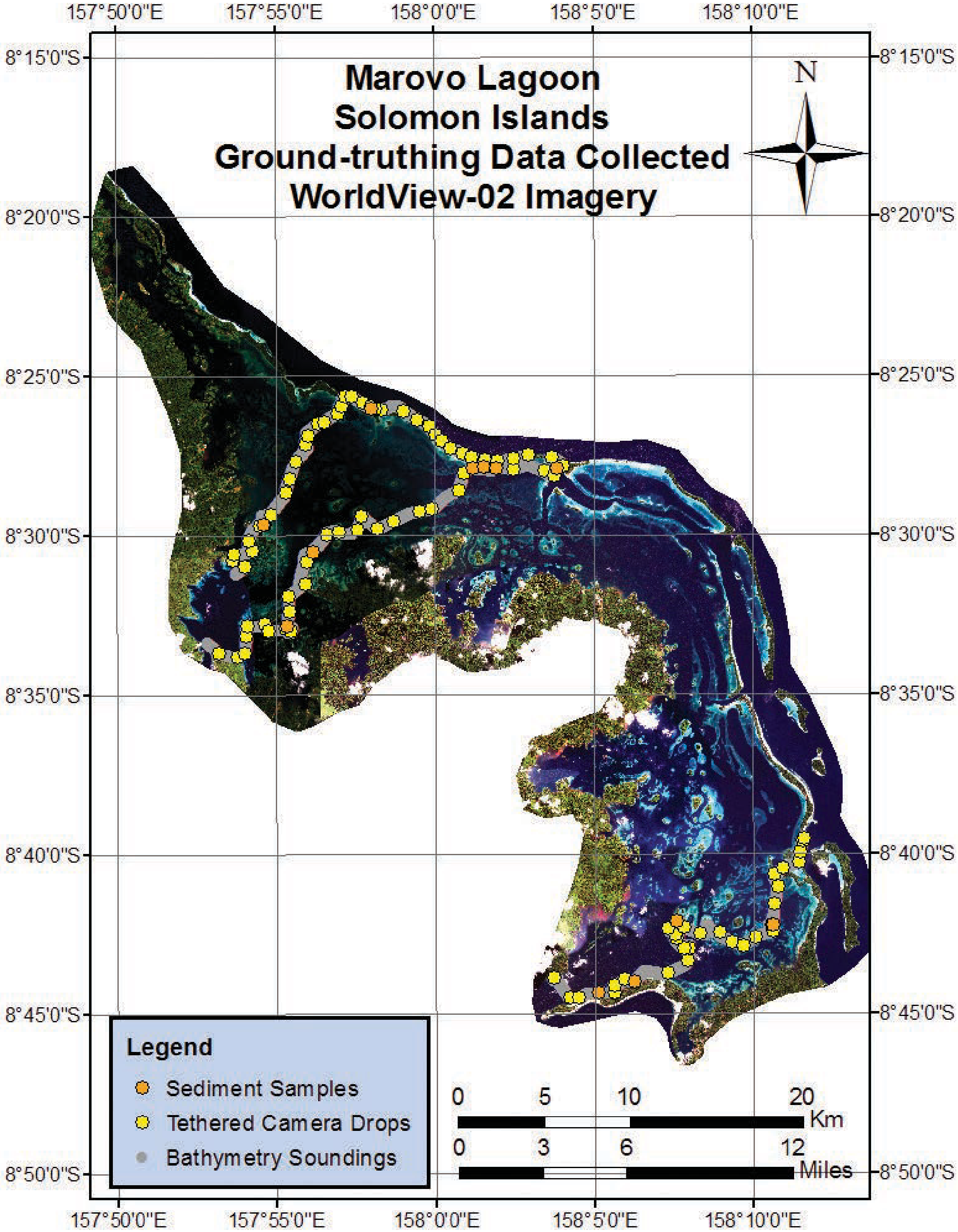
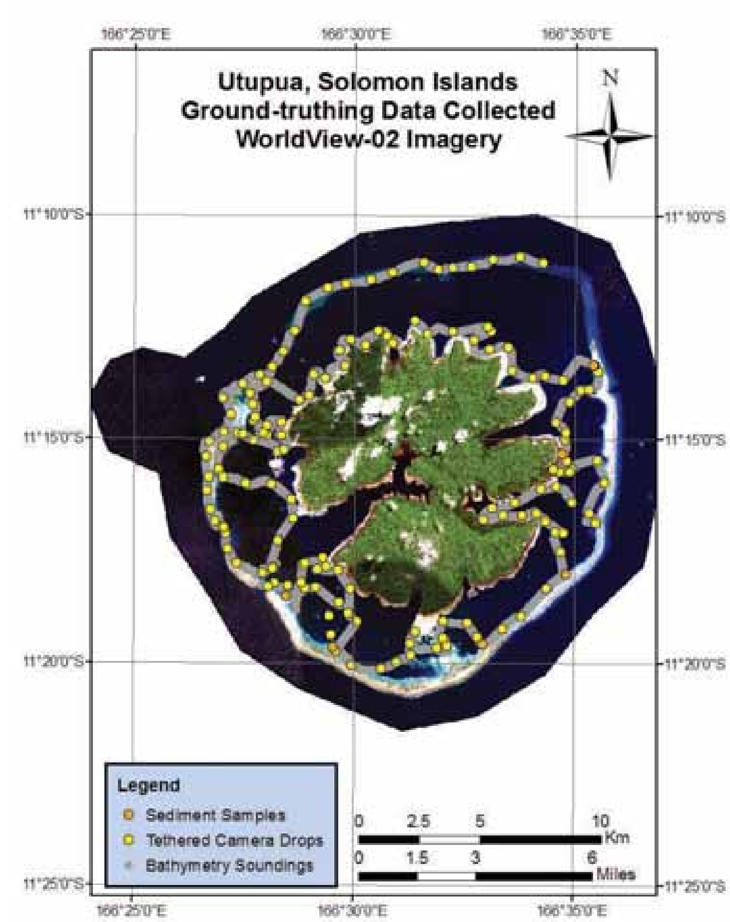


Fig. 19. Track of the research vessel illustrating the locations of bathymetric soundings, drop cameras and sediment samples for Marovo Lagoon.



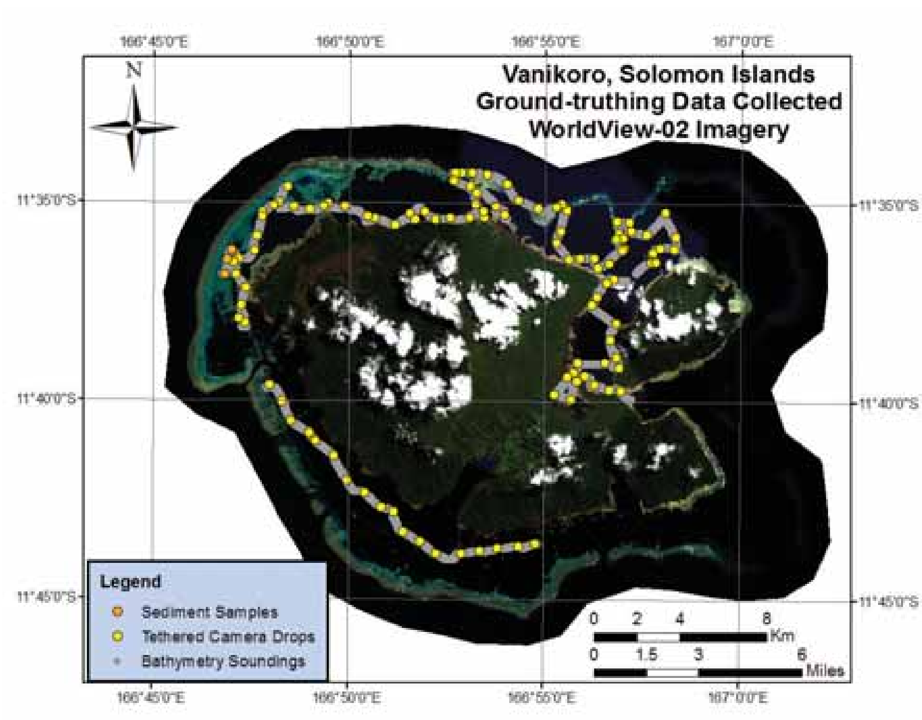
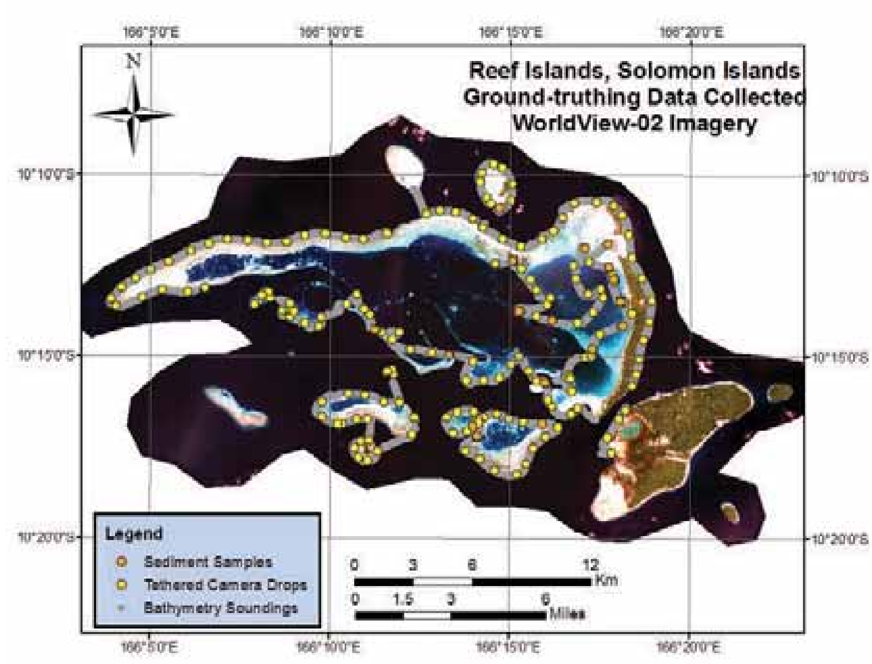


Fig. 20. Track of the research vessel illustrating the locations of bathymetric soundings, drop cameras and sediment samples for Utupua and Vanikoro.



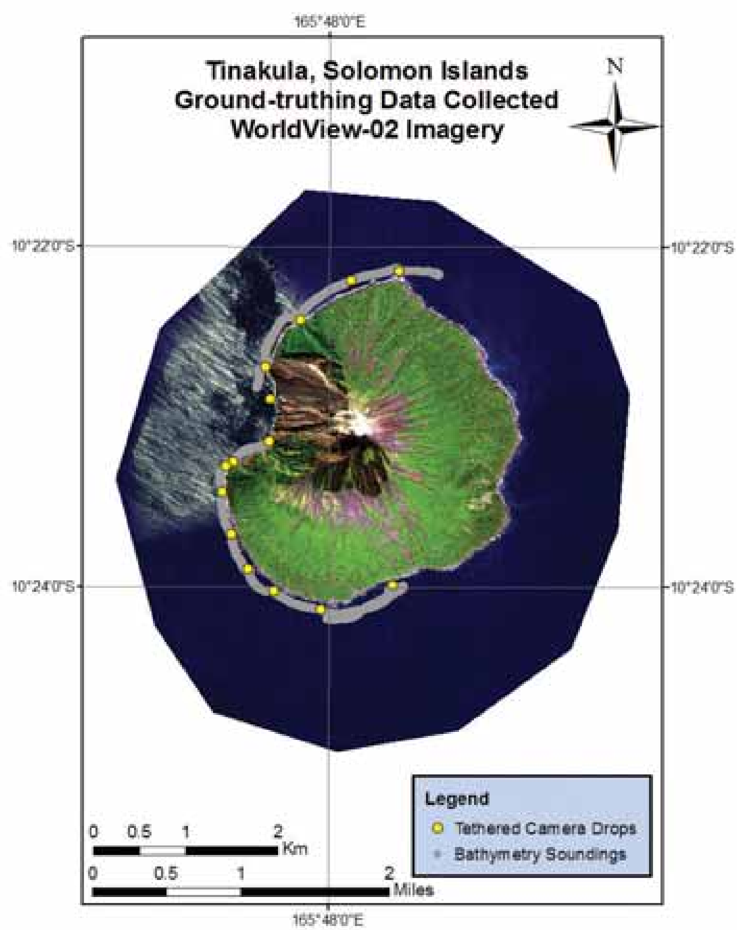


Fig. 21. Track of the research vessel illustrating the locations of bathymetric soundings, drop cameras and sediment samples for Reef Islands and Tinakula.

Coral Reef Assessments

SCUBA surveys were completed on 69 coral reefs within the five regions. Surveys were divided among nine scientists with three conducting benthic point intercept assessments, two for coral belt transects, three for fish transects and one individual doing phototransects. Two scientists also completed additional phototransects and motile invertebrate assessments from 10-30 m depth. Survey locations are summarized in Table and specific locations are shown on figures on subsequent pages.

Location	Date	Latitude	Longitude	Site
Munda	10/29/14	-8.38528	157.2227	SOMU01
Munda		-8.34982	157.2117	SOMU02
Munda		-8.35127	157.2239	SOMU03
Gizo	10/30/14	-8.16024	156.821	SOGZ04
Gizo		-8.15685	156.8961	SOGZ05
Gizo		-8.12720	156.8621	SOGZ06
Gizo	10/31/14	-8.08681	156.7701	SOGZ07
Gizo		-8.10055	156.7978	SOGZ08
Gizo		-8.11413	156.8862	SOGZ09
Kerehikapa	11/01/14	-7.49632	158.0532	S0KR10
Kerehikapa		-7.48290	158.0466	SOKR11
Kerehikapa		-7.44828	158.0211	SOKR12
Sikopo	11/02/14	-7.46136	157.9996	SOSI13
Sikopo		-7.46663	158.0013	SOSI14
Sikopo		-7.43013	157.9618	SOSI15
Malakobi	11/03/14	-7.30422	158.044	SOML16
Malakobi		-7.40641	158.1562	SOML17
Malakobi		-7.36450	158.1978	SOML18
Malakobi	11/04/14	-7.33484	158.0199	SOML19
Malakobi		-7.34819	158.0541	SOML20
Malakobi		-7.35041	158.0761	SOML21
Nono	11/05/14	-8.77211	157.7869	SONN22
Nono		-8.73536	157.8394	SONN23
Nono		-8.82273	157.8087	SONN24
Nono	11/06/14	-8.67533	157.8055	SONN25
Nono		-8.77326	157.7663	SONN26
Nono		-8.74721	158.0933	SONN27
Marovo	11/07/14	-8.40655	157.917	SOMO28
Marovo		-8.43267	157.982	SOMO29
Nono		-8.64352	157.7931	SONN30

Table 3. Coordinates of survey locations during the first half of the mission.

Location	Date	Latitude	Longitude	Site
Bully Point, Lata	11/9/2014	-10.70673	165.83841	SOBP31
Utupua	11/10/2014	-11.28179	166.44778	SOUT32
Utupua		-11.29659	166.46559	SOUT33
Utupua	11/11/2014	-11.26452	166.44485	SOUT34
Utupua		-11.18801	166.53268	SOUT35
Utupua		-11.20967	166.47223	SOUT36
Utupua	11/12/2014	-11.24017	166.45226	SOUT37
Utupua		-11.22784	166.59859	SOUT38
Utupua		-11.33087	166.52095	SOUT39
Utupua	11/13/2014	-11.29004	166.59552	SOUT40
Utupua		-11.30377	166.47469	SOUT41
Utupua		-11.30612	166.46175	SOUT42
Vanikoro	11/14/2014	-11.58562	166.95338	SOVA43
Vanikoro		-11.57767	166.94135	SOVA44
Vanikoro		-11.58442	166.91237	SOVA45
Vanikoro	11/15/2014	-11.57304	167.00087	SOVA46
Vanikoro		-11.59520	166.94562	SOVA47
Vanikoro		-11.56415	166.86845	SOVA48
Vanikoro		-11.59000	166.87600	SN1
Vanikoro		-11.58880	166.86830	SN2
Vanikoro		-11.58430	166.80400	SN3
Vanikoro	11/16/2014	-11.61505	166.78482	SOVA49
Vanikoro		-11.58503	166.80881	SOVA50
Vanikoro		-11.56286	166.82669	SOVA51
Reef Islands	11/17/2014	-10.28400	166.14700	SORI52
Reef Islands		-10.29400	166.29500	SORI53
Reef Islands		-10.28300	166.12700	SORI54
Reef Islands	11/18/2014	-10.26380	166.36910	SORI55
Reef Islands		-10.25800	166.33300	SORI56
Reef Islands		-10.31500	166.34500	SORI57
Reef Islands	11/19/2014	-10.18400	166.22700	SORI58
Reef Islands		-10.19700	166.11100	SORI59
Reef Islands		-10.28420	166.27080	SORI60
Reef Islands	11/20/2014	-10.19370	166.19220	SORI61
Reef Islands		-10.21680	166.07220	SORI62
Reef Islands		-10.28560	166.22720	SORI63
Reef Islands	11/21/2014	-10.16400	166.24820	SORI64
Reef Islands		-10.15190	166.19760	SORI65
Reef Islands		-10.25500	166.25010	SORI66
Reef Islands		-10.21000	166.29400	SN4
Tinakula	11/22/2014	-10.373478	165.813328	SOTI67
Tinakula		-10.396554	165.790431	SOTI68
Tinakula		-10.376161	165.794148	SOTI69

Table 4. Coordinates of survey locations in Santa Cruz.

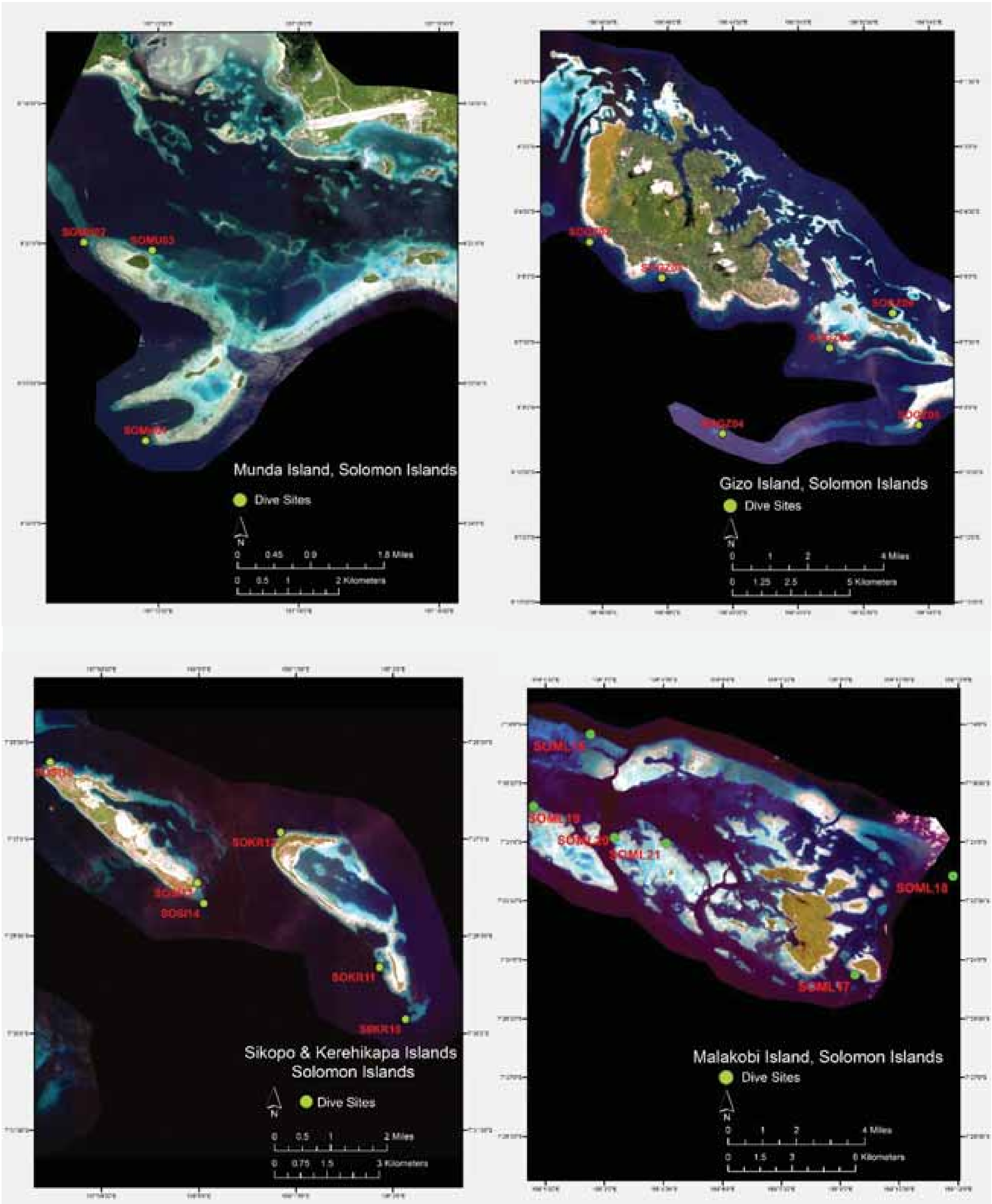


Fig. 22. Survey locations at Munda (top left), Gizo (top right), Sikopo and Kerehikapa (bottom left) and Malakobi (bottom right).

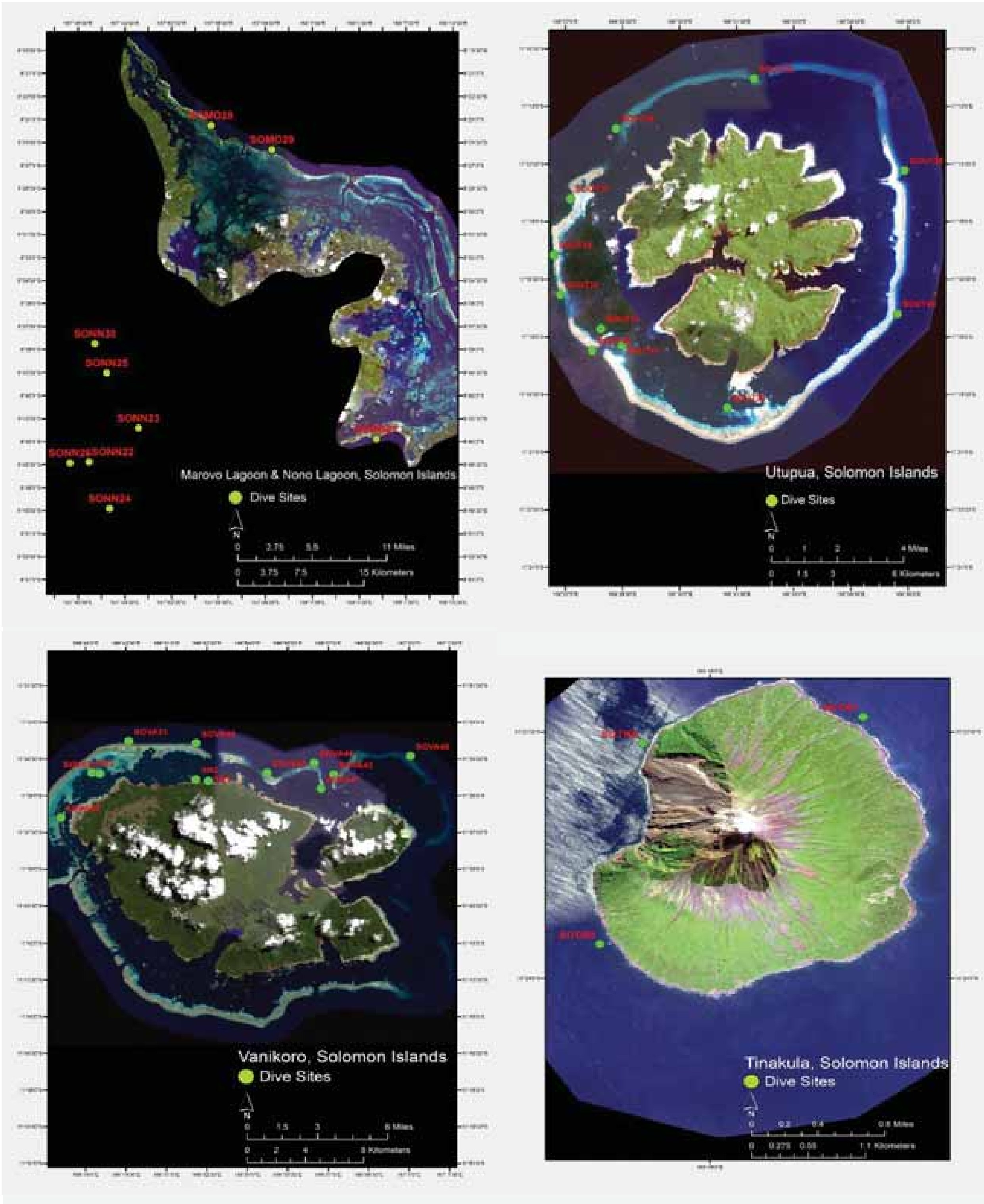


Fig. 23. Survey locations at Marovo and Nono Lagoon, Utupua, Vanikoro and Tinakula.

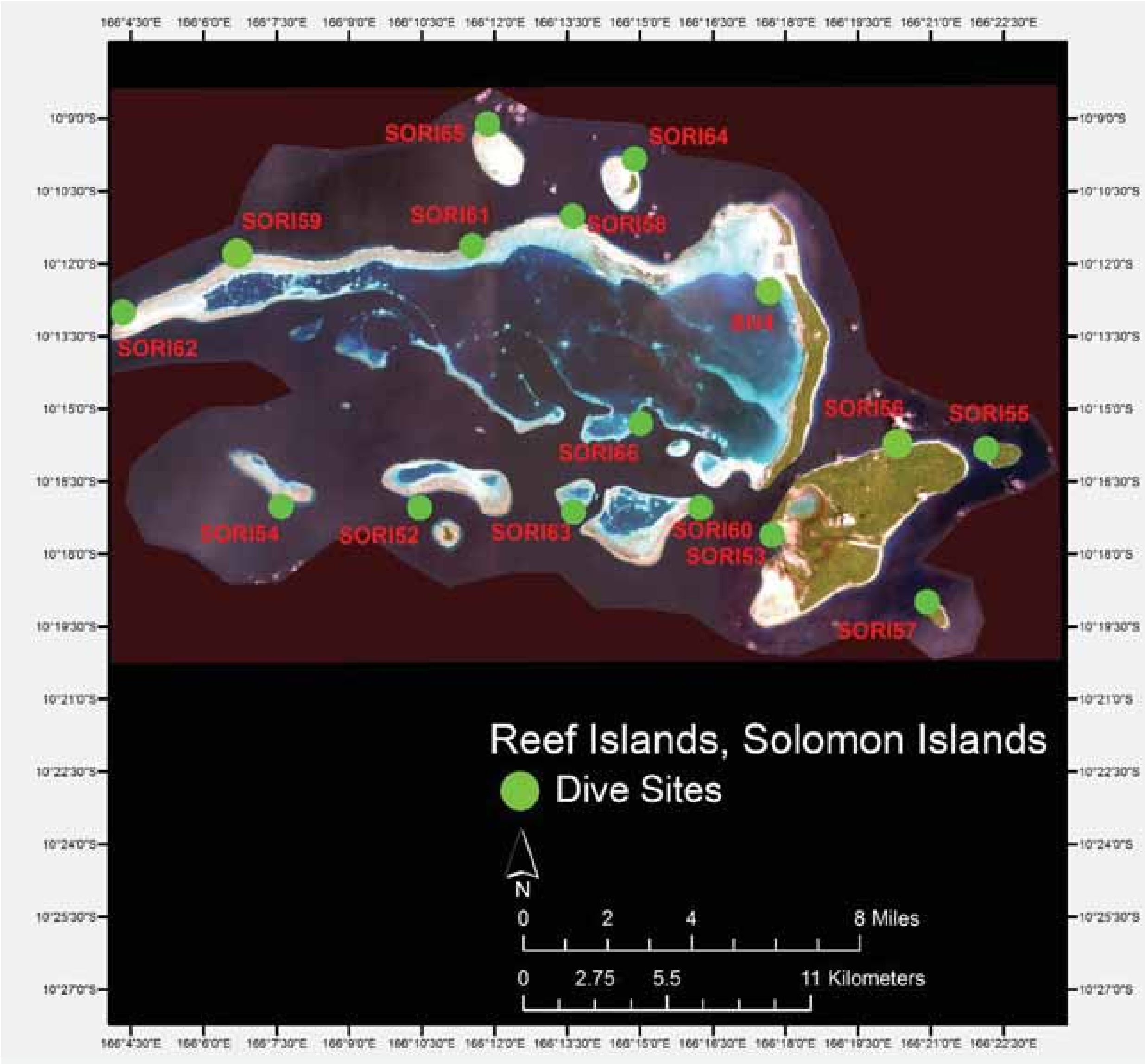


Fig. 24. Survey locations at Reef Islands.

Fig. 25. Large mats of Halimeda and cyanobacteria were noted throughout the Solomon Islands. Cyanobacteria was also often seen overgrowing branching corals, as shown in the image to the left.

Coral Reef Research

Assessment of Acanthaster (crown of thorns starfish) abundance and impacts

Crown of thorns were identified on 14 of the 69 reefs surveyed. In most cases only individual animals were seen. Small collections were made on 11 reefs for size measurements and an examination of the genetic structure of populations. Of these, five reefs had high numbers of COTS (ongoing outbreaks), one in Munda, one in Gizo and three reefs in Reef Islands (Table 5).

Location	Number removed	Number of reefs
Munda Village	15	2
Gizo Island	23	2
Sikopo	4	1
Malakobi	1	1
Utupua	2	1
Vanikoro	2	1
Reef Islands	182	3
Total	**229**	**11**

Table 5. Number of crown of thorns starfish removed from the reefs.

Fig. 26. Measuring crown of thorns sea stars removed from a reef in Reef Islands.

Assessment of the levels of acidification of seawater and impacts on coral communities

Oceanographic measurements taken during the Solomon Islands included 1) CTD casts at each survey location, prior to the assessments; 2) measurements of CO2 at each survey location; and 3) longer term (1-3 day) measurements of pH on an individual reef in each location. These measurements were taken at all sites except only CTD casts were conducted at Munda and Tinakula because we spent only one day in these locations. To assess the baseline CO2 concentration and pH of seawater bathing coral reefs in the Solomon Islands, continuous measurements of surface waters were taken during the dives at each survey location.

Three to four seawater bottle samples (500 ml) were collected from each site visited. Seawater samples were preserved with 2 µl of saturated HgCl2 and sealed with large rubber bands to prevent any changes to the carbonate system before analysis. Total CO2 (TCO2) is being measured coulometrically and total alkalinity (TA) measured utilizing a gran titration by Dr. Derek Manzello (NOAA/AOML) in our laboratory in Miami, Florida (USA).

An autonomous pH sensor (Satlantic SeaFET pH meter) was placed on the seafloor, for duration of a few hours to multiple days depending on the time spent in each region. Typically, the SeaFET was deployed at one site per island. The SeaFET was set to takes measurement every 15 or 30 minutes and was deployed at approximately 10 meters depth.

Measurements of CO2 (µmol/mol) in seawater were made by pumping sea surface water through an equilibrator system to release the carbon dioxide dissolved in seawater. The gas was then measured using a Li-Cor 820 CO2 gas analyzer. The instrument ran continuously for approximately 1 hour at each site and the output values were then averaged for each site. These parameters allowed calculation of the carbonate system of seawater (i.e., partial pressure of CO2 (pCO2), pH and Ω).

Island	No. Cores Count
Munda	6
Gizo	9
Sikopo	9
Malakobi	9
Nono	5
Morovo	2
Utupua	15
Vanikoro	18
Reef Islands	22
Tinakula	1
Total	**96**

Table 6. Cores removed from Porites lobata for growth rate measurements.

Fig. 27. Removing a core from Porites lobata using a pneumatic drill.

Fig. 28. Core removed from a Porites lobata. The diver is filling the core hole with underwater putty to allow the coral to resheet over the plug.

Fig. 29. Sampling a colony of Pocillopora damicornis. A small nubbins is removed using clippers.

Assessment of symbiont composition and photosynthetic efficiency in *Pocillopora*

This component involved two aspects: 1) sampling colonies of *Pocillopora* and *Acropora* from different habitats, depths and locations to characterize their symbionts; and 2) diurnal and nocturnal measurements of the fluorescence of pocilloporid corals using a PAM fluorimeter. In each location the diver started at 30 m and progressively works up to 5 m depth, sampling a minimum of three pocilloporid corals per depth gradient (5, 10, 15, 20, 25, and 30).

In a subsample of the colonies that were sampled (10 colonies per reef or island, all at 10 m depth), triplicate measurements of fluorescence were taken during the day and again at night using a PAM fluorimeter. Additional light readings were taken at 10 m depth over the duration of the research in each island.

An additional aspect included diurnal measurements of Pocillopora colonies in one lagoonal reef in Vanikoro where patchy bleaching was noted. The sampled colonies exhibited mottled bleaching (parts of the colonies appeared to have normal pigmentation and parts were pale).

	Pocillopora							
Islands	***damicornis***	***elegans***	***eydouxi***	***kelleheri***	***meandrina***	***verrucosa***	***woodjonesi***	**Total**
Gizo	8	2	16			27	2	**55**
Kerehikapa	3		4			12		**19**
Malakobi	7	1	5	4		24	1	**42**
Marovo	4	1		2		5		**12**
Munda	5			1		19		**25**
Nono	6	2	3	5		28	1	**45**
Reef Islands	13	12	14	3		38		**80**
Sikopo	3	1	3	2		18		**27**
Tinakula			3	6		9	6	**24**
Utupua	19	12	6	6	2	26	3	**74**
Vanikoro	16	4	5	2	1	44	1	**73**
Total	**84**	**35**	**59**	**31**	**3**	**250**	**14**	**476**

Table 7. Samples of Pocillopora spp. collected for Symbiodinium assessment. All samples (approx.. 1 cm3) were preserved in 20% DMSO solution at -20ºC.

Fig. 30. A slender grouper (Anyperodon leucogrammicus) among coral off Gizo Island.

Coral Health

This research seeks to understand if it is possible to detect sub-lethal levels of stress in corals using molecular biomarkers. Currently, the only way to know if the corals are stressed is if they show signs of stress (e.g. partial colony mortality) which usually occurs after the environmental conditions have already changed. By using expression levels of certain genes, proteins, and metabolites, an index of health will be developed that can be used to forecast the future condition of a reef and identify a potential environmental perturbation before it manifests through coral mortality. One of the dominant reef building coral genera found throughout the Indo-Pacific, *Pocillopora*, is the model animal that was sampled.

In each location, replicate samples of *Pocillopora damicornis* and *Seriatopora* spp. were identified at different depths (5-30 m). The colonies were first assessed for visible signs of stress. A small biopsy (100 mg) consisting of 3-5 polyps is removed from a branch tip. The sample was divided in half: 50% for molecular work, 50% for microscopy. Half the sample was placed in RNALater® or frozen in liquid nitrogen; the other half was fixed in paraformaldehyde and decalcified. All processing will be done in the laboratory in Taiwan. Total number of samples collected are shown in Table 8.

	Pocillopora damicornis		*Seriatopora spp.*	
Island	***weight***	***number***	***weight***	***number***
Bully Point, Lata Island	0.2	1	1.4	7
Gizo	3.2	16	4.6	23
Kerehikapa	2.6	13	2	10
Malakobi	4.4	22	3.4	17
Marovo Lagoon	2.2	11	1.6	8
Munda	1.2	6	1.4	7
Nono Lagoon	2	10	4.2	21
Reef Islands	5.4	27	11.2	56
Sikopo	1	5	2.4	12
Tinakula	0.6	3	0.6	3
Utupua	6.6	33	5.8	29
Vanikoro	4.8	24	5.8	29
Grand Total	**34.4**	**171**	**44.4**	**222**

Table 8. Total number and weight of tissue/skeletal samples collected from Pocillopora damicornis and Seriatopora spp. for biomarker and health assessment.

Education

The Khaled bin Sultan Living Oceans Foundation conducted research and education in the Solomon Islands as a part of the Global Reef Expedition (GRE) from October 29 – November 22, 2014.

During that time the Foundation's education department, led by Director of Education Amy Heemsoth provided land-based education seminars throughout the Solomon islands at primary and secondary schools as well as at communities. Overall, the Foundation conducted 4 school and 25 community seminars and 4 ship tours reaching a total of 2,638 people.

These educational efforts were conducted in partnership with representatives from the Government of the Solomon Islands, a Non-Governmental Organization (NGO) called OceansWatch, and local cultural liaisons. Outlined below are the representatives and their time spent on the mission:

Ministry of Fisheries and Environment

- Ivory Akao, Fisheries Officer (October 29 – November 22)

Local Cultural Liaisons

- Honorable Earnest Fea (November 10-16)
- Chief John Still Niola (November 10-13)
- John Laulae (November 17-22)

OceansWatch

- Georgia Coward, Marine Programs Director (November 10-22)

Below is a general outline of curriculum presented.

Outline of coral reef seminar content

I. About Living Oceans Foundation
II. Where do corals live?
III. What is a coral?
IV. Symbiotic relationship – algae and coral
V. Coral's calcium carbonate "skeleton"
VI. Benefits of coral reefs
VII. Threats to coral reefs
VIII. What can you do to help?

Education Programs

Date	Province	Island	Village	Type	# Reached
10/29/14	Western	New Georgia	Munda	Dunde Community High School	• Primary Students (only half of talk) 150 • Secondary Students: 95 • Teachers: 6 • Principal: 1 • Other adults: 3
10/30/14	Western	Gizo	Titiana	Community	• Adults: 16 • Children: 56
10/31/14	Western	Gizo	Gizo Town	Gizo High School	• Students: 146 • Teachers: 4
10/31/14	Western	Gizo	Gizo Town	Ship Tour	• Adults: 11
11/01/14	Choisul	Wagina	Cookson	Community	• Adults: 20 • Children: 19
11/03/14	Isabel	Ghaghe	Ritamala	Community	• Adults: 8 • Children: 6
11/04/14	Isabel	Santa Isabel	Kia	Community	• Adults: 24 • Children: 26
11/06/14	Western	Buini Tusu	Bareho	Community	• Adults: 53 • Children: 16
11/06/14	Western	Buini Tusu	Chuchulu	Community	• Adults: 36 • Children: 19
11/07/14	Western	Vangunu	Patutiva	Community	• Adults: 44 • Children: 21
11/07/14	Western	Mauro	Nazareth	Community	• Adults: 41 • Children: 77 (from elementary school)
11/11/14	Temotu	Utupua	Nembuo	Community/School	• Adults: 90 • Children: 86 (from elementary school; principal in attendance)
11/11/14	Temotu	Utupua	Asuboa	Community/School	• Adults: 48 • Children: 51
11/12/14	Temotu	Utupua	Aveta	Community	• Adults: 67 • Children: 63
11/12/14	Temotu	Utupua	Nemboa/ Asuboa	Ship Tour	• Adults: 11
11/13/14	Temotu	Utupua	Tanibily	Community	• Adults: 78 • Children: 86
11/13/14	Temotu	Utupua	Matembo	Community	• Adults: 48 • Children: 39

Education Programs

Date	Province	Island	Village	Type	# Reached
11/15/14	Temotu	Vanikoro	Buma	Community	• Adults: 48 • Children: 39
11/15/14	Temotu	Vanikoro	Lavaka	Community	• Adults: 72 • Children: 64
11/16/14	Temotu	Vanikoro	Lale	Community	• Adults: 99 • Children: 89
11/16/14	Temotu	Vanikoro	Buma	Ship Tour	• Adults: 11
11/18/14	Temotu	LomLom	Ngadeli	Community	• Adults: 37 • Children: 31
11/18/14	Temotu	Fenualoa	Mola'a	Community	• Adults: 23 • Children: 29
11/20/14	Temotu	Fenualoa	Malapu	Community	• Adults: 43 • Children: 47
11/20/14	Temotu	Fenualoa	Tanga	Community	• Adults: 57 • Children: 81
11/20/14	Temotu	Fenualoa	Malubu	Community	• Adults: 40 • Children: 32
11/21/14	Temotu	Fenualoa	Tuwo	Community	• Adults: 93 • Children: 66
11/21/14	Temotu	LomLom	Nola	Community	• Adults: 30 • Children: 31
11/21/14	Temotu	LomLom	Ngadeli	Ship Tour	• Adults: 11

Summary

4 Schools: (2 principals; 10 teachers; 241 students)

- 2 primary schools (combined with community talk; students were released from school to attend talk)
- 2 secondary schools

25 Communities: (1,129 Adults; 1,465 Children)

- 25 seminars

Ship tours (44 people)

- 4 ship tours

TOTAL NUMBER OF PEOPLE REACHED: 2,638

Catlin Seaview Survey

The Catlin Seaview Survey is a global scientific expedition creating a baseline record of the world's coral reefs, in high-resolution 360-degree imagery. Having commenced its operations in 2012 on the Great Barrier Reef in Australia, the Catlin Seaview Survey has documented coral reefs in more than 20 countries. During the collaboration with LOF, the Catlin Seaview Survey documented 34 kms of reef in 20 transects during the first 2 weeks of the Solomon Island expedition (New Georgia Islands, Arnavon Islands and Marovo Lagoon, see table below). The benthic community data extracted from these images will be collated in a free online research tool accessible by all for use in future conservation and academic investigations as well as for the management of coral reefs (globalreefrecord.org). Also, our unprecedented and highly engaging 360-degree panorama imagery is posted freely online, with the aim to engage the general public in coral reef conservation, essentially giving the entire world online population the opportunity to take a 'virtual dive' and see the wonders of the reef for themselves.

In addition to taking panoramic images of reefs, we conducted fish surveys using traditional belt transects, with the aim to determine to what extent the Catlin Seaview Survey methodology is suitable for extracting data on fish diversity and abundance. Fish surveys were carried out at 10 of the 20 SVII survey sites along three 5m x 50m belt transects over the first 150m of the respective SVII transect.

SVII Methods:

During 1-2 km long transects, a series of 360-degree high-definition digital images were taken of the reef, using custom designed self-propelled camera vehicles. The camera system is similar to that used for Google StreetView, and results in a series of 360-degree images which online viewers can interact with. For each transect location, continuous benthic imagery was taken along the 10m-depth contour of the chosen reef site. Each 2 kilometer transect generates ca. 1,000 high-definition panoramic images, which are processed with computer vision methodologies to extract benthic community composition descriptions at multiple scales.

The SV-II self-propelled camera system is composed of 3 Canon 5RMk2 cameras with 67 megapixel resolution set up in a custom underwater housing to provide panoramic coverage. Images are taken every 3 seconds or approximately every three meters. GPS coordinates are recorded with a GPS tracking unit towed by diver operating the SVII to provide GPS coordinates for each image.

Table: GPS coordinates of the start and end of each SVII transects conducted. Fish surveys were conducted at locations indicated in white.

Location	Date	Dive Start Lattitude	Dive Start Longitude	Dive End Lattitude	Dive End Longitude
Munda	10/29/14	'8''22.01666S'	'157''14.05872E'	'8''22.04491S'	'157''14.03953E'
Munda	10/29/14	'8''22.91831S'	'157''13.78863E'	'8''23.17784S'	'157''13.52768E'
Gizo Island	10/30/14	'8''9.39221S'	'156''52.43544E'	'8''9.54869S'	'156''51.55464E'
Gizo Island	10/30/14	'8''7.12343S'	'156''51.44724E'	'8''7.60648S'	'156''51.61871E'
Gizo Island	10/31/14	'8''4.86466S'	'156''51.58179E'	'8''4.64523S'	'156''51.29820E'
Gizo Island	10/31/14	'8''4.84478S'	'156''52.03051E'	'8''4.56278S'	'156''51.21891E'
Arnavon Islands	11/1/14	'7''28.46751S'	'158''2.78540E'	'7''28.27084S'	'158''2.16607E'
Arnavon Islands	11/1/14	'7''26.88965S'	'158''1.74023E'	'7''27.23851S'	'158''2.35118E'
Arnavon Islands	11/2/14	'7''28.67215S'	'158''2.77053E'	'7''29.53794S'	'158''3.25232E'
Arnavon Islands	11/2/14	'7''28.17595S'	'158''2.04471E'	'7''27.71751S'	'158''1.46713E'
Malakobi Island	11/3/14	'7''21.01568S'	'158''4.49522E'	'7''21.43843S'	'158''5.08194E'
Malakobi Island	11/3/14	'7''20.98614S'	'158''4.48131E'	'7''20.57037S'	'158''4.00936E'
Malakobi Island	11/4/14	'7''22.70513S'	'158''5.02518E'	'7''23.08688S'	'158''5.35187E'
Malakobi Island	11/4/14	'7''21.50991S'	'158''5.09097E'	'7''22.06835S'	'158''5.09097E'
Marovo Lagoon	11/5/14	'8''40.62860S'	'157''50.36609E'	'8''40.62553S'	'157''50.68067E'
Marovo Lagoon	11/5/14	'8''42.08243S'	'157''48.94201E'	'8''41.47533S'	'157''48.98602E'
Marovo Lagoon	11/6/14	'8''24.28535S'	'157''54.92663E'	'8''23.87412S'	'157''54.71141E'
'Marovo Lagoon'	11/6/14	'8''25.50863S'	'157''57.00826E'	'8''26.18383S'	'157''56.96017E'
Marovo Lagoon	11/7/14	'8''37.45506S'	'157''49.28121E'	'8''37.43183S'	'157''49.36277E'
Marovo Lagoon	11/7/14	'8''38.48589S'	'157''47.66817E'	'8''38.48787S'	'157''47.67876E'

Fig. 31. Catlin Seaview Survey team in the Solomon Islands