

VOL
15

GLOBAL REEF EXPEDITION

GLOBAL REEF EXPEDITION FINAL REPORT



Khaled bin Sultan
Living Oceans
Foundation

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The Khaled bin Sultan Living Oceans Foundation (KSLOF) is a nonprofit organization dedicated to providing science-based solutions to protect and restore ocean health. KSLOF was incorporated in California as a 501(c)(3), public benefit, private operating foundation in September 2000. Since then, the Living Oceans Foundation has worked to conserve the world's oceans through research, outreach, and education.

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EXECUTIVE SUMMARY

Coral reefs offer a variety of ecosystem services, including sustenance, economic opportunities, and protection from natural disturbances, as well as playing an essential cultural role for thousands of communities. However, globally, the extent of the world's reefs is being degraded at an astounding rate. The coral reef crisis has led to substantial coral declines ranging from 40% in the Indo-Pacific to more than 80% coral loss in the Caribbean. To better understand the coral reef crisis, the Khaled bin Sultan Living Oceans Foundation (KSLOF) embarked on the Global Reef Expedition (GRE), the world's largest coral reef survey and high-resolution habitat mapping initiative, to assess the status of Earth's reefs during a period of time. Data collected on the expedition will help scientists and marine managers better understand the extent of the coral reef crisis and provide valuable baseline data that can be used in both local and large-scale conservation efforts.

The expedition was conducted by KSLOF, a US-based nonprofit environmental organization dedicated to providing science-based solutions to protect and restore ocean health. Starting as early as 2001, the foundation conducted field research to survey and map coral reefs to aid in coral conservation efforts. These research missions culminated in the Global Reef Expedition, which brought together an international team of over 200 scientists, educators, photographers, and filmmakers who circumnavigated the globe surveying some of the most remote coral reefs in the world. This report presents findings from the intensive GRE field research, education, and outreach that took place from 2006-2015, and from this point forward, references to the GRE in this document reflect the findings from the work completed during this period.

From 2006-2015, the GRE visited 16 countries and territories around the globe, starting along the Saudi Arabian Red Sea coastline, traveling throughout the Caribbean and tropical Pacific Ocean, and ending in the Chagos Archipelago in the Indian Ocean. Local representatives from the communities provided invaluable knowledge and helped us share our findings with the residents. Our team of scientists used standardized methods to map and assess the benthic and fish

communities, allowing us to evaluate the reefs across large geographic areas. To better understand large-scale trends, we grouped data into three datasets: the Saudi Arabian Red Sea, the Caribbean, and combined data from the Pacific and Indian Oceans.

The primary scientific goals of the expedition were to:

- 1 Map and characterize coral reef ecosystems.**
- 2 Identify the current status of and major threats to the world's reefs.**
- 3 Examine factors that enhance a reef's ability to resist, survive, and recover from disturbance events such as bleaching, cyclone damage, and crown-of-thorns starfish outbreaks.**

As the science team was conducting research, our team of educators worked in real time with communities to share discoveries. In turn, knowledge of how the local communities managed their marine resources was shared with the scientists at sea. Our photographers and filmmakers produced award-winning films to showcase the work and transport audiences to places they may have never otherwise seen.

MAPPING THE WORLD’S REEFS

Using high-resolution satellite imagery, KSLOF was able to map over 65,000 km² of coastal marine habitats in 11 countries and territories across the globe. This mapping endeavor produced the most comprehensive atlas of ground-truthed high-resolution coral reef habitat maps. Two publications, the [Atlas of the Saudi Arabian Red Sea Habitat](#) and the [Atlas of Shallow Marine Habitats of Cay Sal Bank, Great Inagua, Little Inagua, and Hogsty Reef, Bahamas](#), were released by the foundation and are freely available on our website. One of the most useful tools developed because of the mapping component of the GRE is the web-based [World Reef Map](#). This is a global, online, interactive map that allows users to explore all the surveyed coral reefs. These maps continue to be used by scientists and managers to aid in management and conservation efforts globally.

BENTHIC ASSESSMENT OF THE WORLD’S REEFS

KSLOF conducted nearly 8,600 benthic surveys at over 1,200 survey stations around the world. Globally, coral reef benthic communities varied by location. In the Red Sea, the highest mean (±S.E.) coral cover was in the Farasan Banks (29.4±13.4%) and the lowest was found in Ras Al-Qasabah (20.4±10.4%). Macroalgal cover was high in shallow locations in the Farasan Islands and nearshore reef flat communities in the Farasan Banks and parts of Ras Al-Qasabah, but in Al Wajh and Yanbu, crustose coralline algae and turf algae were the dominant algae groups observed.

In all locations surveyed in the Caribbean, algae dominated the substrate, with a mean (±S.D.) of 65±14% across all locations. Macroalgae was the most abundant algae observed in all locations. Mean live coral cover for each country in the Caribbean ranged from <8% to 14%, with The Bahamas having the lowest live coral cover and St. Kitts and Nevis having the highest.

In the Pacific and Indian Oceans, the benthic communities had high coral cover, and the algal communities were dominated by crustose coralline and turf algae. The reefs of the Gambier Archipelago in French Polynesia had the highest mean live coral cover (52±13%), followed by the Republic of Palau (49±16%) in the Pacific Ocean. The Chagos Archipelago in the Indian Ocean had a mean live coral cover of 40±16%. New Caledonia and the Cook

Islands had the highest percentage of algae recorded but were both dominated by crustose coralline algae.

FISH ASSESSMENT OF THE WORLD’S REEFS

Our fish experts conducted over 8,300 fish surveys across all locations to better understand the status of the world’s reef fish populations. Overfishing was evident in nearly every location we surveyed on the GRE. Some studies estimate that a baseline biomass threshold for reef fish should fall between 11 and 19 kg per 100 m²,

GRE BY THE NUMBERS	
65,000	Square Kilometers of Coral Reefs Mapped
53,657	Kilometers Traveled (1.25 times around the world)
20,675	Hours SCUBA Diving (541 days underwater)
11,189	Dropcam Videos
8,596	Benthic Surveys
8,314	Fish Surveys
7,152	Education Seminar Attendees
5,911	Coral Samples Taken
1,460	Fish Species Recorded
1,242	Dive Sites
1,108	Coral Reefs Studied
488	Coral Species Recorded
467	Days of Research
216	Scientists
107	Islands
26	Research Missions
16	Countries
10	Years
1	The Most Important Coral Reef Expedition in History

EXECUTIVE SUMMARY

and most locations fell at or below that threshold. Almost every location had few large commercially important fish, with most of the fish biomass instead composed of small fish in the lowest trophic levels.

The fish of the Red Sea were diverse, but some species appeared to be depleted, including many top predators like sharks and groupers. The fish communities of the Red Sea had varying reef fish communities that were highly dependent on the benthic communities. Generally, the sharks and large groupers were rarely seen, and instead some of the largest fish seen on the reefs were parrotfish.

The fish communities on Caribbean reefs had very low fish biomass, and most fish were herbivores. The Bahamas had the highest mean fish biomass (11 ± 9.5 kg per 100 m²) and second-highest mean fish density (61 ± 25 fish per 100 m²) in the Caribbean. Colombia had a higher mean fish density than The Bahamas but the second-lowest mean fish biomass (5.6 ± 2.8 kg per 100 m²), showing the fish there were abundant but small.

The fish communities of the Pacific and Indian Oceans varied greatly by location. The Tuamotu Archipelago in French Polynesia had the highest fish density (279 ± 165 fish per 100 m²) and second-highest fish biomass (39 ± 48 kg per 100 m²) of all locations surveyed in the Pacific and Indian Oceans. The Kingdom of Tonga had alarmingly low fish density (92 ± 46 fish per 100 m²) and biomass (4.5 ± 4.1 kg per 100 m²), the lowest of all locations surveyed in the Pacific and Indian Oceans. The highest fish biomass (42 ± 20 kg per 100 m²) was found

in the Galapagos Islands, which was due to the high number of sharks and other large top predators found at this location.

EDUCATION ON THE GRE

The education and outreach teams launched several in-country programs to share the foundation's knowledge about coral reefs with community members, traditional leaders, local teachers, and schoolchildren. In total, over 7,000 people attended coral reef seminars, community events, and ship tours in Jamaica, French Polynesia, Tonga, Fiji, and the Solomon Islands. The government and community seminars proved to be especially important. Not only was the foundation providing education about coral reefs, but also, we received valuable local environmental information from the participants.

USING PHOTOGRAPHY AND FILM TO BRING THE GRE TO THE REST OF THE WORLD

The *M/Y Golden Shadow* served as an incredible platform from which to photograph and record high-resolution footage in parts of the world that had never been recorded before. Using this footage, we were able to develop and broadcast our award-winning films, such as our 2015 Suncoast Emmy® winning film, [Sharks of the Coral Canyon](#), to communities around the world. These films and photographs brought to life the research that we were conducting. We were able to bring the coral reefs that we were studying into living rooms and classrooms worldwide.

This report provides an assessment of the state of **corals and reef fish** for over **1,000 coral reefs** surveyed on the **Global Reef Expedition**.

FIVE MAIN TAKEAWAYS FROM THE GRE

There were many things learned from our research on the Global Reef Expedition. Whether we were visiting some of the most remote untouched reefs or reefs being used by local communities, each one had a story to tell and added to our knowledge about the extent of the coral reef crisis.

The five main takeaways from the GRE are:

1) Swift action is needed to address climate

change. Climate change is currently the biggest threat that the world's reefs are facing. Coral bleaching and ocean acidification are a direct result of climate change, and regardless of the status of a reef, these two disturbances will have substantial impacts globally if climate change is not addressed.

2) Reef fish populations are being overexploited globally.

One of the most significant findings from the GRE was that nearly every country we visited showed signs of overfishing. Almost all countries had predominantly small fish remaining, particularly in families fished for subsistence and commercial fishing. Most reef fish populations are unable to withstand the fishing pressure they are currently experiencing, and expansion and enforcement of fishing regulations is critical.

3) We need better management of acute reef disturbances.

Both natural and human-induced disturbances are having a negative impact on coral reefs. Widespread coral mortality from crown-of-thorns starfish outbreaks was seen in Saudi Arabia, French Polynesia, Tonga, and the Solomon Islands, and we witnessed an active outbreak occurring in the Cook Islands. Most of the natural acute disturbances, such as tsunamis, storms, and crown-of-thorns starfish outbreaks, are hard to manage. Managing and relieving other reef stressors such as nutrient runoff and overfishing can help reefs recover from these acute disturbances.

4) Marine Protected Areas (MPAs) work in conserving coral reefs. We were able to work in some of the world's oldest and largest MPAs. Some countries we visited, such as Australia (Northern Great Barrier Reef), Palau, and New Caledonia, have large human populations utilizing the reefs and have prioritized establishing large protected and managed areas to conserve their nearshore reef systems. In nearly every

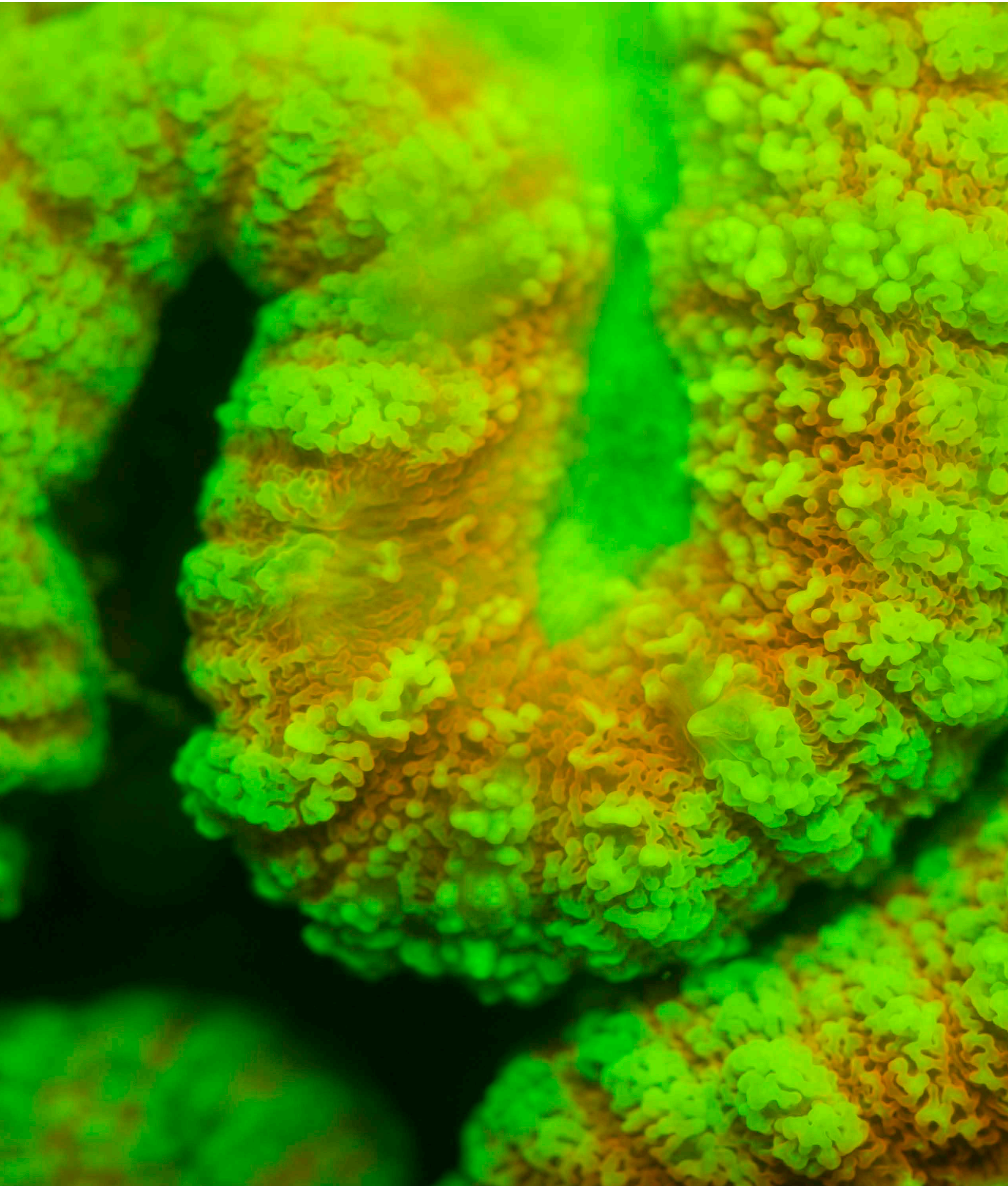
instance, these reefs had the best coral and reef fish communities. Protecting remote reefs and using marine spatial planning to strategically place no-take, no-entry MPAs can help engender coral reef resilience.

5) Collaboration with local communities has the biggest impact on reef conservation.

In order to protect and conserve the world's reefs, aggressive measures will need to be taken. One of the biggest takeaways from the GRE was that nearly every community we worked with around the world expressed, and continues to express, the want and need for conservation of its reef systems. Working directly with the communities, continuing education programs, sharing our findings, and expanding on their current management efforts has proven to be the most successful in conserving the reefs visited on the GRE.

The GRE took place at a critical time, providing a baseline dataset that is being used by scientists and managers around the world to help battle the ongoing coral reef crisis. Over 100 peer-reviewed scientific papers, reports, and management plans have been published using data collected on the GRE. Our work has helped establish internationally recognized Marine Protected Areas and locally managed areas around the globe. Currently, our maps are being used in partnership with NASA to help map the remainder of the world's reefs. These maps can be used to aid in conservation efforts at an even larger scope than the already expansive GRE.

Drastic measures are needed to address the coral reef crisis. KSLOF hopes the findings in this report, as well as our many resources that resulted from the GRE, will be used by scientists, managers, and communities around the world to support their conservation efforts. This expedition would not have been feasible without the tireless work of our partners and everyone who participated on the GRE. The gracious financing and support from His Royal Highness Prince Khaled bin Sultan Abdulaziz Al-Saud made this work possible, and for that, we will be forever indebted.



GLOBAL REEF EXPEDITION

1.0

INTRODUCTION



INTRODUCTION

1.0

The Khaled bin Sultan Living Oceans Foundation (KSLOF) is a US-based nonprofit environmental science organization that was established in 2000 by His Royal Highness Prince Khaled bin Sultan Abdulaziz Al-Saud. As an avid scuba diver, Prince Khaled witnessed the rapid decline of the world's coral reefs during his travels throughout his lifetime. After investigating the reasons the reefs were declining, he chose to act. He was inspired to establish an organization dedicated to understanding, conserving, and preserving our precious oceans for generations to come.

Prince Khaled, with support from his closest advisors, chose to use a three-pronged approach to undertake this mission to protect the world's oceans by establishing three departments of the foundation: Science, Education, and Outreach. Together, these departments work synergistically to educate and share science-based solutions to protect and restore the oceans' ecosystems, particularly coral reefs. Because coral reefs are found in countries and territories across the globe, Prince Khaled established the **Science Without Borders**[®] philosophy, which became core to the foundation's

operation. Subsequently, KSLOF formed partnerships with scientists, conservation organizations, and local leaders to leverage the resources, commitment, and ideas necessary to make substantial progress in ocean conservation. Through these partnerships, the foundation recognized a gap in the understanding of coral reefs on a global scale. Therefore, KSLOF launched numerous expeditions starting in 2001 to assess the state of the reefs in 24 countries and territories across the tropical oceans (Figure 1). These research missions intensified in 2006, leading to the Global Reef Expedition (GRE), the world's largest coral reef survey and high-resolution habitat mapping initiative.

Embracing the three-pronged approach, the foundation enabled a broad team of educators, filmmakers, photographers, and scientists to work in some of the most remote locations in the world. One of the main goals of the GRE was to use a collaborative approach to study and map coral reefs by partnering with scientific and local experts in each of the countries visited. To do this, Prince Khaled retrofitted and graciously donated the use of his ship, the *M/Y Golden Shadow*, to support the

Figure 1

LOCATION OF ALL SITES VISITED ON THE GLOBAL REEF EXPEDITION FROM 2001-2021. THIS EXPEDITION CIRCUMNAVIGATED THE GLOBE TO M... IN THIS REPORT IS FROM THE INTENSIVE FIELD WORK THAT TOOK PLACE BETWEEN 2006 AND 2015 [MARKED BY CORAL-COLORED DOTS] IN: GALAPAGOS ISLANDS (2012), FRENCH POLYNESIA (2012-2013), COOK ISLANDS (2013), FIJI (2013), TONGA (2013), NEW CALEDONIA (2013), AUST...

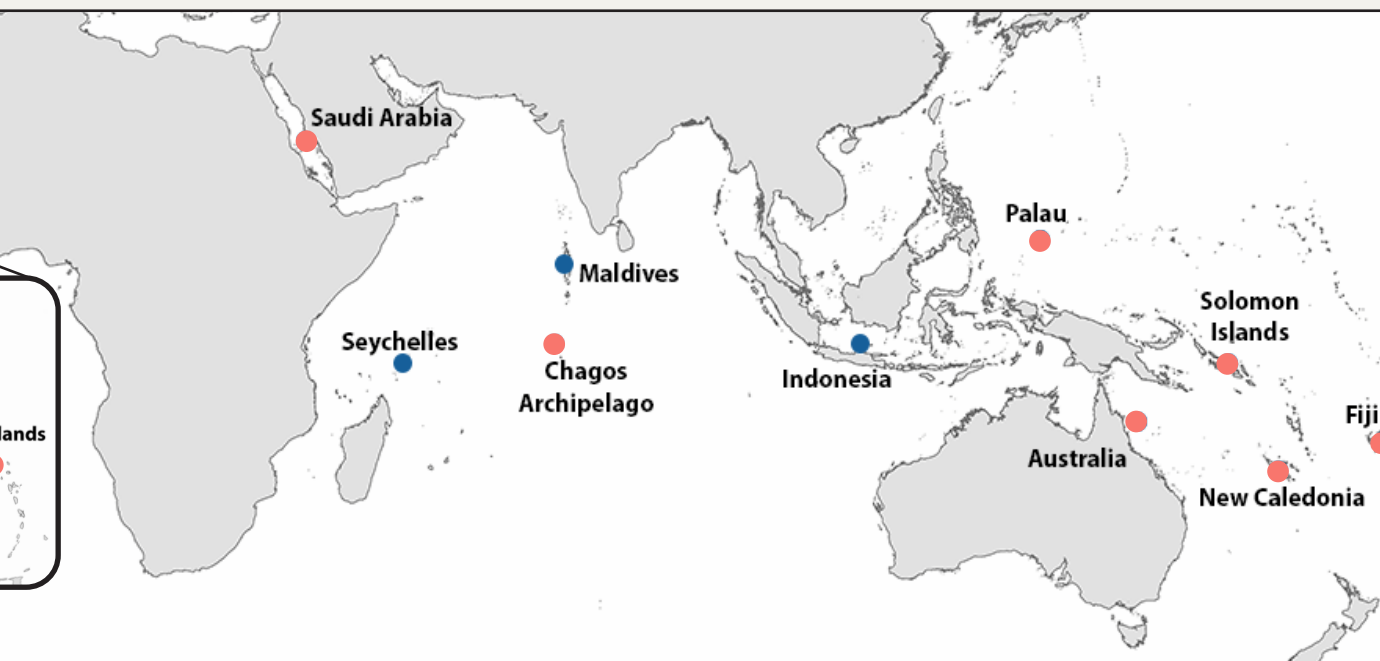


field team and facilitate its work on a portfolio of the most remote and understudied reefs. To achieve this goal, the foundation assembled over 200 coral reef experts from 25 different countries to map and study the benthic and fish communities around the world. The culmination of the work completed on the GRE can be found in the more than 100 peer-reviewed [scientific papers, reports,](#) and [atlases](#) that were published as a result of this expedition. This publication will focus on the intensive field research conducted in 16 countries between 2006 and 2015 (Figure 1), and from here forward, references to the GRE reflect the findings from fieldwork completed during this time period.

From 2006-2009, the foundation surveyed the reefs along the Saudi Arabian coastline in the Red Sea. Between 2011 and 2015, the foundation continued its circumnavigation of the globe, traveling through the Caribbean, then into the Eastern Pacific, South Pacific, Western Pacific, and finally the Indian Ocean. Along the way, KSLOF scientists and partners applied standardized sampling protocols to map and survey the reefs in each of these regions.

While the science team was conducting underwater surveys, the foundation implemented various education and outreach programs in parallel to improve ocean literacy and inspire the next generation of ocean advocates. New education curricula and programs were established as a direct result of the GRE, including the foundation's Coral Reef Educator on the Water (CREW) program, the Mangrove Education and Restoration Program, the Coral Reef Ecology Curriculum, and the Science Without Borders® Challenge. Initially, the education team hosted seminars for hundreds of elementary and high school students in the Washington, D.C., area, sharing discoveries from the GRE in near real time. After this initial round of seminars, the team joined the GRE scientists in the field to connect with local students and communities. The education team worked directly with cultural liaisons in Jamaica, French Polynesia, Tonga, Fiji, and the Solomon Islands to share information about the GRE, learn how local communities were using and managing their marine resources, and educate students about coral reefs, while showcasing the foundation's award-winning films.

MAP AND COLLECT BASELINE DATA OF THE WORLD'S CORAL REEF BENTHIC AND FISH COMMUNITIES AT A POINT IN TIME. THE DATA PRESENTED INCLUDES THE SAUDI ARABIAN RED SEA (2006-2009), THE BAHAMAS (2011), ST. KITTS AND NEVIS (2011), JAMAICA (2012), NAVASSA (2012), COLOMBIA (2012), AUSTRALIA (2014), SOLOMON ISLANDS (2014), PALAU (2015), AND THE CHAGOS ARCHIPELAGO (2015).





GLOBAL REEF EXPEDITION

2.0

**SCIENTIFIC
BACKGROUND**



SCIENTIFIC BACKGROUND

2.0

THE VALUE OF CORAL REEFS

Coral reefs and adjacent nearshore tropical marine ecosystems play a vital role in the lives and livelihoods of people living in coastal communities across the globe. They offer a variety of ecosystem services, including providing sustenance, economic opportunities, and protection from storms, while also playing an important cultural role for thousands of communities¹. Using the M/Y Golden Shadow, the GRE granted scientists the opportunity to visit some of the most remote reefs in the world, many of which had never been mapped or surveyed before. This allowed our team of scientists to capture the status of these reefs and gain valuable scientific information on remote reefs that are far away from many human threats such as fishing, coastal development, and pollution.

2.1

REEFS IN CRISIS

Globally, there is a coral reef crisis, where reefs are being lost or degraded at an astounding rate². Scientists have estimated that over the past three decades, live coral cover has fallen by up to 80% in the Caribbean, 40% in the Indo-Pacific, and 50% on the Great Barrier Reef³⁻⁶. Several anthropogenic and natural disturbances have been contributing to the decline of the world's reefs and, considering these large-scale ecological changes, the GRE took place at a critical time.

Starting as far back as the late 1990s, the coral reef crisis was highlighted by numerous scientists who saw the need to address this rapid and global decline of coral reefs^{2,7,8}.

An increase in human impacts has led to ecological phase shifts from coral-dominated to macroalgal-dominated reefs, a decrease in the resilience of the reef ecosystem, and reduced fitness of many reef organisms². Since the problem was first recognized, several mitigation efforts have been employed to address the reef crisis. Some of the most common management practices include regulating nearshore runoff and pollution, fisheries management, and adaptive management to shifting baselines². Despite these mitigation efforts and due to compounding pressure from both anthropogenic and environmental disturbances, the reefs are still declining.

The primary scientific goals of the GRE were to:

- 1 Map and characterize coral reef ecosystems.**
- 2 Identify the current status of and major threats to the world's reefs.**
- 3 Examine factors that enhance a reef's ability to resist, survive, and recover from disturbance events such as bleaching, cyclone damage, and crown-of-thorns starfish outbreaks.**

2.2 SMALL CHANGES CAN HAVE CATASTROPHIC IMPACTS

Coral reef ecosystems are one of the most complex systems on Earth. A change in just one species can have catastrophic effects on the entire ecosystem, and globally, we have seen widespread impacts on the reef system from acute and localized disturbances. One common disturbance observed throughout the Pacific and Indian Oceans was the outbreak of *Acanthaster planci*, commonly known as crown-of-thorns starfish, or COTS. COTS are corallivores who prey directly on corals, and a rapid increase in their population or an outbreak can substantially reduce live coral cover on a reef⁹⁻¹¹.

On the GRE, we witnessed multiple areas where COTS outbreaks caused extensive damage to reefs. This was particularly true in French Polynesia and the Cook Islands. We also found evidence of previous COTS outbreaks in the Red Sea, Tonga, the Solomon Islands, and

the Chagos Archipelago. The cause of these destructive outbreaks has been difficult to identify, but numerous theories attribute them to pollution and high local nutrient inputs, enhanced levels of phytoplankton and subsequent increase in larvae survival, overfishing, and decreases in their natural predators¹²⁻¹⁴. Encouragingly, some areas we visited that had recently experienced outbreaks showed signs of recovery. When we observed an active outbreak, we took action to help communities physically remove these voracious predators and establish management practices to help conserve the remaining corals¹⁵.

In 1983-1984, the Caribbean reefs also experienced an acute disturbance that contributed to the phase shift from coral- to macroalgal-dominated reefs in many locations throughout the Caribbean. The black sea urchin, *Diadema antillarum*, found throughout the tropical waters of the Western Atlantic, experienced mass mortality due to a disease outbreak. Its population rapidly decreased by about 95% throughout its range^{16,17}. The urchin is a functional grazer that helps regulate the coral and macroalgal dynamics on the reefs by controlling the macroalgal growth. Combined with this mass

mortality event, disease outbreaks starting as early as the late 1970s, widespread bleaching events occurring nearly annually, and increased severity of storm damage have led to a decline of coral cover throughout the Caribbean basin by up to 80% from 1975-2000¹⁸. While the mass mortality of *Diadema* in the Caribbean occurred decades

before the GRE, we found nearly all the locations surveyed were macroalgae-dominated reefs. The data collected on the GRE provides valuable insight into the threats coral reefs are currently experiencing. Both acute, like the ones described above, and large-scale disturbances, such as disease outbreak and coral bleaching events, have contributed to the decline in the world's reefs. The GRE provides valuable data on the status of the world's reefs that can be used to monitor and better understand the resilience of reefs to these disturbances.

Globally, coral reefs are being lost or degraded at an astounding rate.

SCIENTIFIC BACKGROUND

2.3 MANAGING REEF FISH POPULATIONS

An estimated 800 million people live within 100 kilometers of coral reefs, and just one square kilometer of reef is valued at USD \$600,000 annually¹⁹. A study by Teh et al. (2013) estimated that there are six million reef fishers in 99 countries and territories globally²⁰. The reefs of the world produce 10-12% of the fish caught in tropical nations and 20-25% of the fish caught in the developing nations of the Pacific, Indian, Middle East, and Caribbean²¹. Across the tropical Pacific nations, it is estimated that 90% of the daily protein consumed by local communities comes directly from the adjacent reefs²¹.

Most rural reef fishers target nearshore reef fish for both sustenance and subsistence. Unfortunately, these nearshore reef fish populations are either poorly regulated or unregulated in many fisheries management practices. Overfishing of nearshore coral reefs is a complex problem and is often unaddressed due to the lack of information on reef fish community structure²². It was important for KSLOF scientists to look not only at the benthic organisms but also at reef fish populations in both heavily fished and remote locations where the

reefs experienced less fishing pressure. Coral and reef fish have an interdependent relationship²³ where corals provide habitat structure for fish, and in return, many fish help graze the reef, regulating the algal cover that can impede coral settlement and growth²⁴. When a reef is overfished, it can have widespread effects on the benthic community and negatively impact the delicate reef system. Studies in the Caribbean Sea and Indian Ocean suggest that minimum reef fish biomass targets should fall between 1,195 and 1,900 kg per ha (or 11 and 19 kg per 100 m²)^{25,26} because it is not only sustainable for reef fish populations, but also, it will help maintain critical ecosystem services, food security, and resilience of reefs currently in crisis.

In nearly every location surveyed on the GRE, evidence of overfishing was present. Because of the heavy reliance on reef fish for sustenance in coastal communities, the GRE fish surveys provide critical information for local governments to better understand the status of their reef fish populations and use the data to establish best management practices as fishing pressure continues to increase.

2.4 THE NEED FOR THE GLOBAL REEF EXPEDITION

Historically, humans have overexploited nearshore reef ecosystems to a point where recovery feels like a futile effort. Recording the status of the world's reefs at a specific point in time on a large scale provides scientists and managers with valuable information that can be used for both local and large-scale conservation efforts. This is particularly true as the effects of climate change continue to worsen in both extent and severity. Since the start of the GRE, there have been numerous historic global coral bleaching events caused by prolonged ocean warming²⁷.

Many of the locations surveyed on the GRE were affected by these catastrophic events where substantial coral cover mortality has been recorded. The GRE data presented herein was collected between 2006 and 2015, before the most recent global bleaching events, and may be useful for future recovery efforts. As the coral reef crisis continues to worsen, KSLOF hopes the data used in this report will help scientists and managers around the world better protect coral reefs so they can be enjoyed by future generations.

The **data** collected on the
Global Reef Expedition
can help people address the
coral reef crisis and
protect coral reefs for
future generations.



GLOBAL REEF EXPEDITION

3.0

METHODS



METHODS

3.0

SITE DESCRIPTIONS

The data presented in this report combines findings from multiple islands and sites throughout each location surveyed. A list of the sites visited can be found in [Appendix 2](#). The team of KSLOF scientists and partners surveyed a total of 1,206 stations among the 16 locations visited. An impressive 8,596 benthic habitat surveys and 8,314 fish surveys were conducted on the GRE, providing the foundation with the largest global database of field-collected reef data so far acquired using a standardized survey protocol. [Table 1](#) shows the total number of benthic and fish surveys conducted in each country.

While researchers were surveying the reefs, another team from KSLOF was ground-truthing and mapping over 65,000 sq. km of coastal marine habitats at a high resolution, which has been made freely available for interpretation on our website ([Figure 2](#)). This mapping endeavor has produced the most comprehensive atlas of ground-truthed high-resolution coral reef habitat maps. Additionally, the maps produced on the GRE are helping examine shifts in tropical marine coastlines around the world²⁸⁻³².

The research conducted on the GRE would not have been possible without the *M/Y Golden Shadow*, its crew, and its support vessels, which were graciously donated for use, allowing KSLOF researchers to easily gather data in these remote locations.

Analysis for this report grouped data into three datasets. One compared the locations surveyed along the Saudi Arabian Red Sea coastline: the Farasan Islands, Ras Al-Qasabah, Al Wajh, Yanbu, and the Farasan Banks; the second compared locations surveyed in the Caribbean: The Bahamas, Jamaica, Navassa, St. Kitts and Nevis, and Colombia; the third combined locations surveyed in the Pacific and Indian Oceans: the Galapagos Islands, French

Table 1 SAMPLING INTENSITY OF THE COUNTRIES SURVEYED ON THE GLOBAL REEF EXPEDITION. THE TABLE SHOWS THE TOTAL NUMBER OF SITES, BENTHIC TRANSECTS, AND FISH TRANSECTS OF EACH LOCATION SURVEYED ON THE GRE.

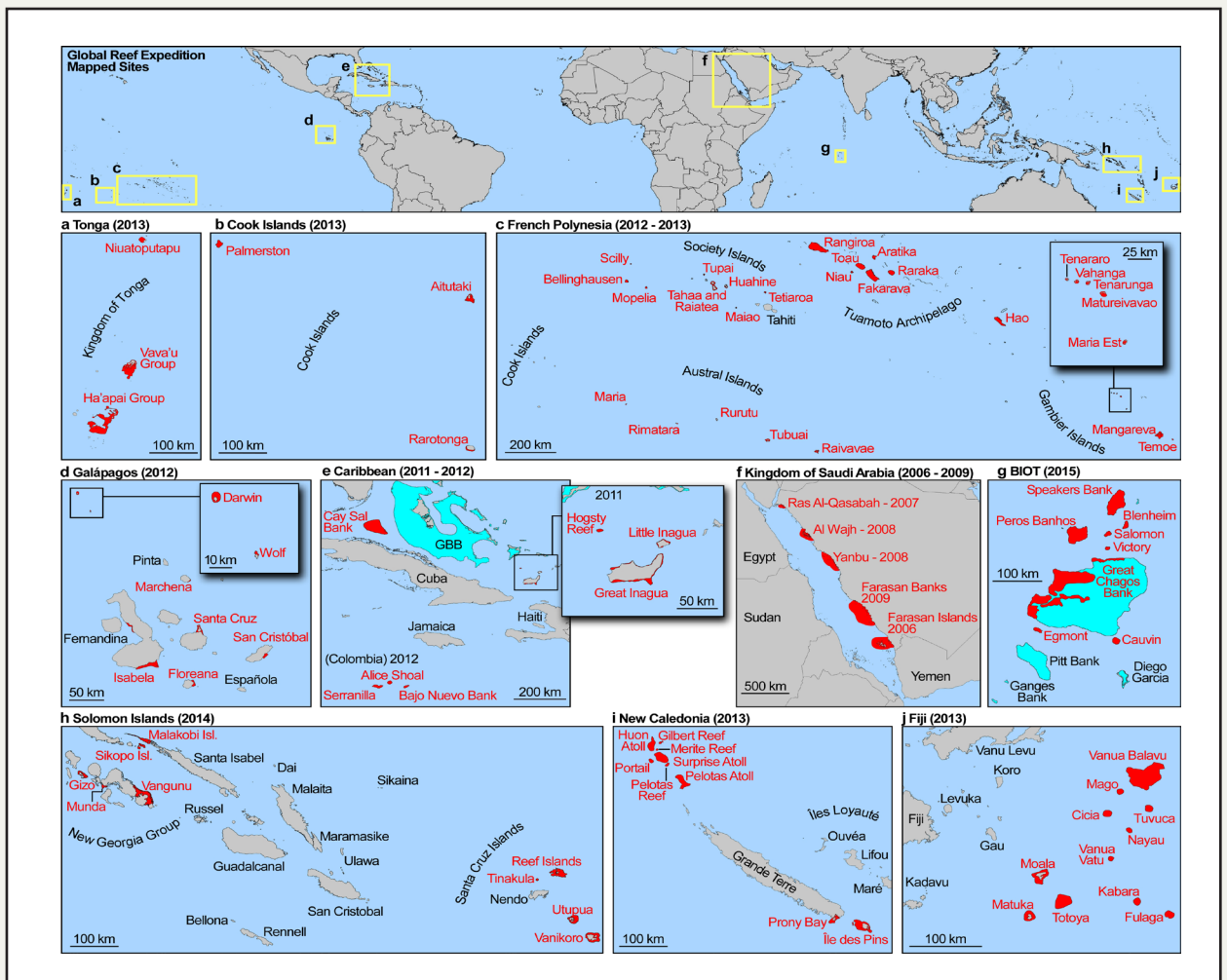
LOCATION	NUMBER OF SITES	NUMBER OF BENTHIC SURVEYS	NUMBER OF FISH SURVEYS
BAHAMAS	80	653	780
CHAGOS ARCHIPELAGO	105	1,559	1,222
COLOMBIA	31	197	284
COOK ISLANDS	30	175	238
FRENCH POLYNESIA, AUSTRAL ARCHIPELAGO	30	264	177
FRENCH POLYNESIA, GAMBIER ARCHIPELAGO	54	315	303
FRENCH POLYNESIA, SOCIETY ARCHIPELAGO	70	367	507
FRENCH POLYNESIA, TUAMOTU ARCHIPELAGO	98	675	486
GALAPAGOS ISLANDS	15	67	97
JAMAICA	19	143	187
LAU PROVINCE, FIJI	64	313	363
NAVASSA	15	106	99
NEW CALEDONIA	74	562	505
NORTHERN GREAT BARRIER REEF	162	961	728
PALAU	86	1,004	878
SAUDI ARABIAN RED SEA	128	384	384
SOLOMON ISLANDS	68	453	640
ST. KITTS AND NEVIS	23	84	244
TONGA	54	314	192
GRAND TOTAL	1,206	8,596	8,314

Polynesia, the Cook Islands, the Lau Province in Fiji, the Kingdom of Tonga, New Caledonia, the Northern Great Barrier Reef in Australia, the Solomon Islands, the Republic of Palau, and the Chagos Archipelago.

Because of the expanse of the four archipelagos in French Polynesia, we chose to analyze them separately as the Austral, Society, Tuamotu, and Gambier Archipelagos.

Figure 2: a-j

LOCATION OF THE SITES VISITED ON THE KHALED BIN SULTAN LIVING OCEANS FOUNDATION GLOBAL REEF EXPEDITION FROM 2006-2011 WHERE HABITAT AND BATHYMETRIC MAPS WERE PRODUCED. RED POLYGONS EMPHASIZE EXTENT OF MAPPING AND ENCOMPASS A TOTAL AREA OF 65,000 SQ. KM OF HABITAT SITUATED SHALLOWER THAN 25 M WATER DEPTH. ACCOMPANYING SITE NAMES ARE IN RED. GBB IN FIGURE 2E ABBREVIATES GREAT BAHAMA BANK. NORTH IS TOP IN ALL MAPS; SCALES AS NOTED. FIGURE AND CAPTION REPRODUCED WITH PERMISSION FROM PURKIS ET AL. (2019).



● AREAS MAPPED

METHODS

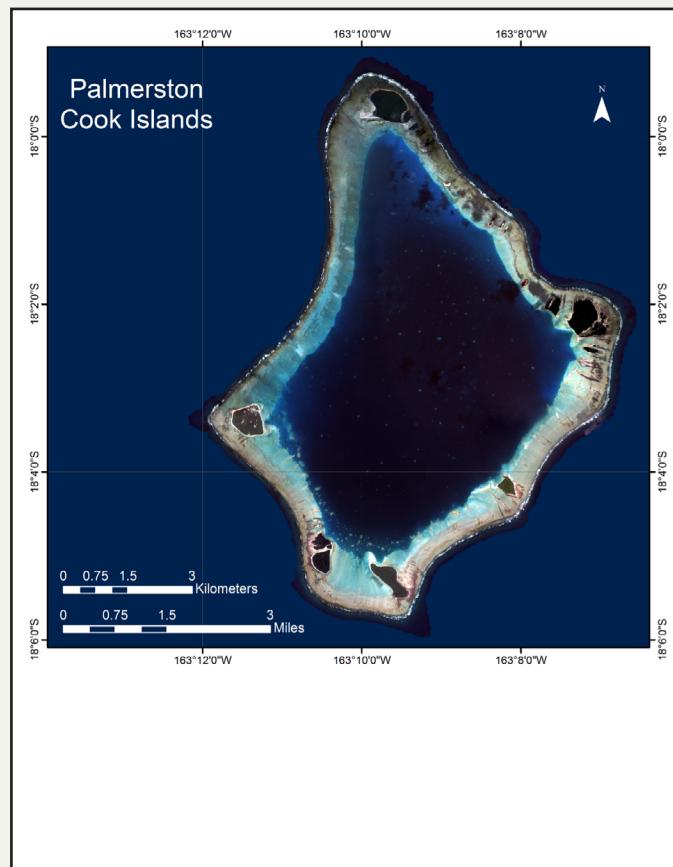
3.1 HABITAT MAPPING

Using multispectral Quickbird and WorldView-2/3 satellite imagery (DigitalGlobe Inc., Colorado, USA), in combination with data obtained from aerial surveys and ground-truthing by KSLOF fellows and researchers, high-resolution bathymetric maps and thematic habitat maps were created for shallow marine environments of 10 countries, spanning the Red Sea, Caribbean Sea, and Pacific and Indian Oceans (see examples of map outputs in [Figures 3a-c](#))¹⁵. The remote sensing data and its derivatives will be useful not only for marine spatial planning but also as a reference for future research on the world's reefs. The generated maps extend from the shoreline to approximately 25 m water depth. Ground-truthing, which was used to define habitat classes and guide interpretation of the remote sensing data, included the continuous acquisition of depth soundings, drop-camera deployment, sediment and hard substrates, snorkel and dive assessments, and fine-scale photo-transect surveys. A publication by Purkis et al. (2019) provides a comprehensive description of our mapping methodology and findings from the GRE during the time period covered by this report²⁹.

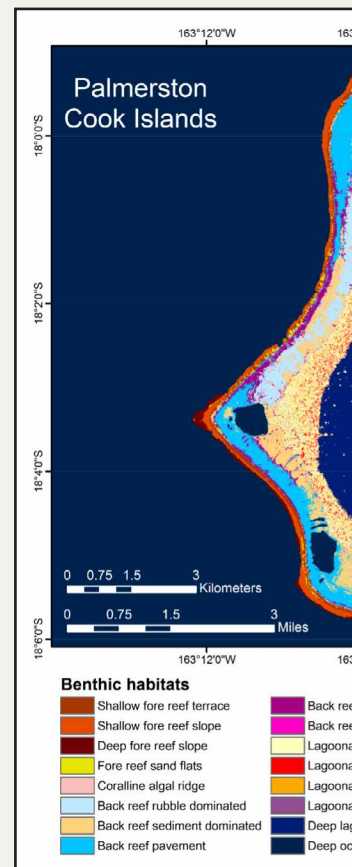
Figure 3

EXAMPLE OF (A) A TRUE-COLOR SATELLITE IMAGE CAPTURED FROM THE WORLDVIEW-2 SENSOR, (B) A HABITAT MAP, AND (C) A SPECTRALLY-DERIVED BATHYMETRY MODEL. THESE THREE EXAMPLE OUTPUTS ARE OF PALMERSTON ATOLL, COOK ISLANDS.

(a) SATELLITE IMAGE



(b) HABITAT MAP WITH CLASSIFICATION

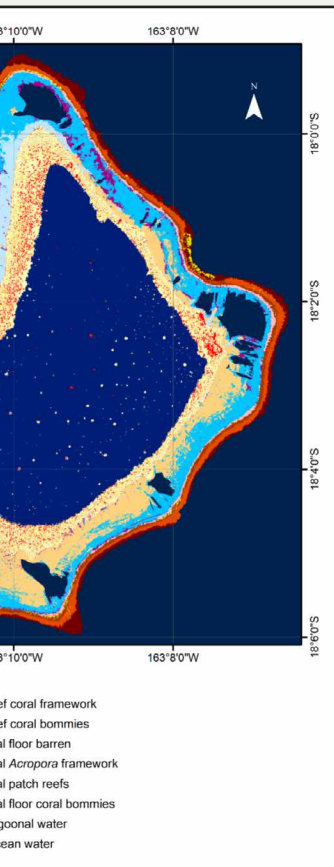


3.1

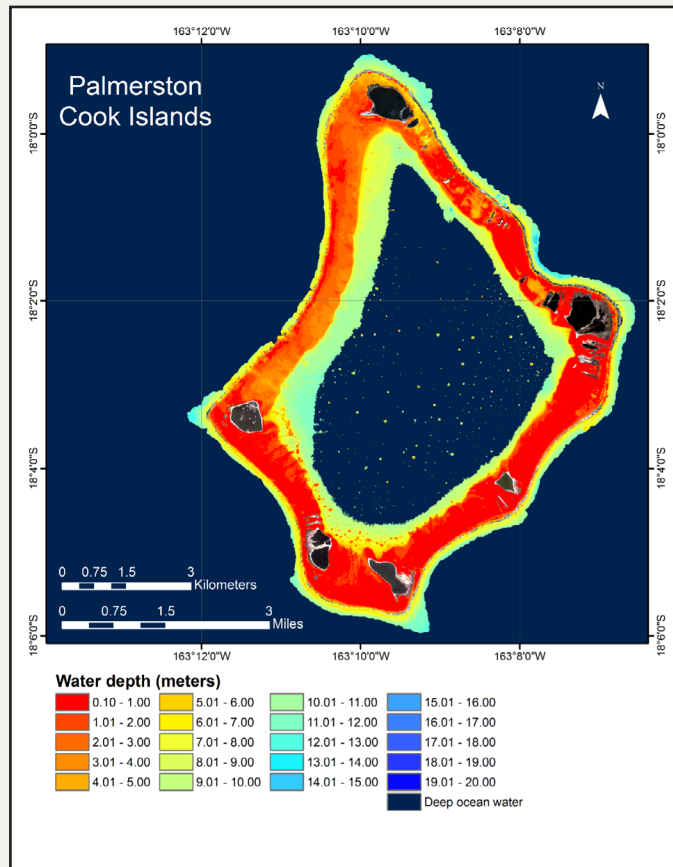
a SATELLITE IMAGERY

KSLOF acquired a total of 65,000 km² of DigitalGlobe Inc. Quickbird and WorldView-2/3 (8 band) satellite imagery for the regions mapped. The satellite images had a spatial resolution of 2 m x 2 m (each pixel covers a 4 m² area), enabling real-time navigation in the field to locate features of interest. KSLOF fellows from Nova Southeastern University used the scenes in conjunction with a differential GPS device to navigate throughout the coral reefs. Modelers used the imagery, combined with the ground-truthing data, to create bathymetric and benthic habitat maps (Figure 4)^{29,33}.

ATIONS



(c) BATHYMETRY MAP WITH DEPTHS



METHODS

Figure 4

SEAVIEWER
UNDERWATER VIDEO
'DROP-CAM' USED
TO RECORD BENTHIC
COMPOSITION
AROUND EACH
ISLAND.



3.1

b

BENTHIC VIDEO

KSLOF scientists used an underwater tethered digital video camera, commonly termed a “drop-cam,” to gather video of the benthic composition at each drop-cam location (Figure 4). At each point, the drop-cam was lowered from the survey boat to within 0.5 m of the seafloor and video recorded for up to 60 seconds. During this time, the laptop operator watched the video in real time and guided the drop-cam operator to raise or lower the camera to avoid any topography. In this manner, damage to marine life was prevented. The video was recorded on a ruggedized laptop, with position, time, date, boat heading, and boat speed digitally etched into the video stream. Drop-cam deployment was limited to depths shallower than 40 m due to the length of the tether cable (50 m).

3.1

c

HABITAT CLASSIFICATIONS

Classifications of all the marine and terrestrial habitat types were determined using satellite imagery, ground-truthing, and benthic video surveys. The combination of all data collected was used for the development of a habitat classification scheme and training of eCognition software to develop object-based classification models²⁹. A total of 82 habitat types were defined for all the studied sites (Appendix 1).

3.1

d

ACOUSTIC WATER DEPTH SOUNDINGS

Sonar soundings were gathered by KSLOF fellows along transects using a Syqwest Inc. Hydrobox, a single-beam acoustic transducer operating at 50 Hz (Figure 5). Each sounding was positioned using differential GPS, and the data was recorded on a ruggedized laptop. The soundings were used to train a satellite water-depth derivation model, which is based on the spectral attenuation of light in the water column³³. The final topo-bathymetric maps have the same spatial resolution as the satellite imagery from which they were extracted (i.e., 2 m x 2 m). The total number of depth soundings along with the number of drop camera videos and total area mapped by country can be found in Table 2.

Figure 5

ACOUSTIC SONARS USED IN THE SURVEYS. SUB-SEABED PROFILER (LEFT) AND SINGLE-BEAM SONAR (RIGHT).



Table 2

A SUMMARY BY COUNTRY OF THE MAPPING COMPONENT OF THE THE GLOBAL REEF EXPEDITION. THIS TABLE WAS REPRODUCED WITH PERMISSION FROM PURKIS ET AL. (2019).

Location	Year Fieldwork Conducted	Area of Reef Mapped (km ²)	Number of Drop Camera Videos	Number of Depth Soundings
Saudi Arabia	2006-2009	31,419	1,759	2,711,903
Bahamas	2011	7,801	1,054	1,928,148
Colombia	2012	1,103	446	364,771
Galapagos	2012	1,030	593	1,258,413
French Polynesia	2012-2013	7,802	1,645	8,650,690
Cook Islands	2013	1,100	596	1,055,627
Fiji	2013	2,542	987	3,037,823
Tonga	2013	2,322	724	1,602,931
New Caledonia	2013	3,024	1,218	3,142,899
Solomon Islands	2014	2,965	962	3,458,261
Chagos Archipelago	2015	3,951	1,205	4,459,966
Total		65,059	11,189	31,671,432

METHODS

3.2

CORAL REEF COMMUNITY SURVEYS

The KSLOF scientists and fellows on the GRE used a combination of quantitative methods, including belt transects, point intercept transects, and quadrats, to assess benthic and fish communities of reefs surveyed on the GRE. Surveys completed in the Caribbean followed the Atlantic and Gulf Rapid Reef Assessment (AGRRA) methodology, which is standard for assessing the reefs in this region³⁴. The remainder of the GRE followed a similar methodology using the point-intercept method and belt transects to measure the status of the reefs. This standardized collection methodology provides robust data that can be compared regionally and globally.

3.2

a

BENTHIC COVER ASSESSMENTS

The AGRRA and KSLOF benthic surveys followed a similar methodology, with the only exception being the identification of coral in the Red Sea and Pacific and Indian Oceans to the genus level, rather than species level, as adopted in the Caribbean. Cover of major functional groups and substrate types (Box 1) were assessed along 10 m transects using recorded observations and/or photographic assessments. The major functional groups assessed included corals identified to genus or species; other sessile invertebrates, such as giant clams, anemones, and others, identified to phylum or class; and six functional groups of algae: crustose coralline algae (CCA), erect calcareous algae, cyanobacteria, fleshy macroalgae, turf algae, and turf mixed with sediment. At least two KSLOF surveyors used scuba-recorded observations to quantify benthic cover using a point-intercept method across all locations. This technique required the surveyor to place a 10 m transect line and record the organism and substrate type at every 10 cm mark (total 100 points per transect). A minimum of four transects were completed at each survey station (Figure 6), and when possible, surveys were completed at 25, 20, 15, 10, and 5 m water depths.

At some locations in the Red Sea, Pacific, and Indian Ocean, a photographic assessment was conducted to supplement the point-intercept surveys. On occasion, we were not able to complete the point-intercept

Box 1

CLASSIFICATION OF SUBSTRATE AND COVER TYPES RECORDED DURING BENTHIC TRANSECT SCUBA SURVEYS.

BENTHIC HABITAT	
SUBSTRATE TYPE	
	Live Coral
	Dead Coral
	Fused Rubble
	Pavement
	Rubble
	Sand/Sediment
	Recently Dead Coral
LIVE COVER	
	Algae
	Macroalgae
	Crustose Coralline Algae (CCA)
	Erect Coralline Algae
	Turf Sediment
	Turf
	Cyanobacteria
	Other Invertebrates
	Coral (to Genus)

surveys at every depth due to scuba time limitations, so we supplemented this dataset with photographic assessments. In this sampling technique, a scientific diver used a 1 m × 1 m quadrat, flipping it over a total of 10 times per transect to photograph a full 1 m × 10 m photo-transect (Figure 7) at each depth. When possible, the diver completed at least one survey at 20, 15, 10, and 5 m depths at each site.

To measure the benthic community, the digital photographs were downloaded and analyzed using Coral Point Count with Excel Extensions (CPCe), a software developed by Nova Southeastern University's National Coral Reef Institute (NCRI)³⁵. The 1 m × 1 m images were imported into the software, where 50 random points were overlaid on each photograph. A KSLOF scientist then defined the organism and substrate type directly underneath the point (Figure 8). This data was then exported into a Microsoft Excel (2013) spreadsheet and added to the benthic survey database for further analysis.

To measure overall coral diversity by genus, we used the Simpson Diversity Index, which is commonly used to characterize species diversity in a community³⁶. This index uses the total number of individual coral colonies of a specific genus observed per transect and location, and the total number of genera, to provide a number to represent the total diversity of the island community. The calculated diversity index values will fall between 0 and 1, with the low diversity being close to zero and the high diversity close to one. For the Caribbean, and Pacific and Indian Ocean basins datasets, we used total coral genera counts across all locations in each region to standardize the coral diversity index. Doing this allows us to compare the data within each of the geographic regions. Because the coral species found in the Caribbean are not the same as those in the Pacific and Indian Ocean basins, we calculated the diversity separately for these two regions.

The benthic substrate cover percentages were calculated for each transect, then averaged by site. Further statistical analysis was completed using R-software to determine the relationships between the metrics measured³⁵. Site averages were used to measure country-wide assessments addressed in this report.

Figure 6

A DIVER CONDUCTING A BENTHIC SURVEY. DIVER USES A 10 M TRANSECT LINE AND RECORDS BENTHIC SUBSTRATE TYPE AND COVER EVERY 10 CM.



Figure 7

A DIVER TAKES A PHOTO OF A 1M × 1M SQUARE QUADRAT. TEN PHOTOS FOR EACH TRANSECT ARE COMPLETED AT DIFFERENT DEPTHS TO SUPPLEMENT DATA COLLECTED USING TRANSECT LINES AS SHOWN IN FIGURE 6.

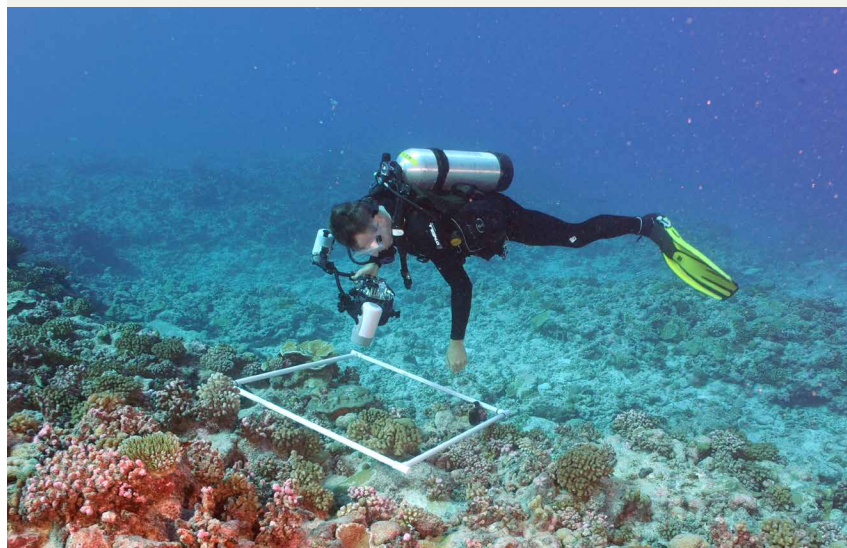
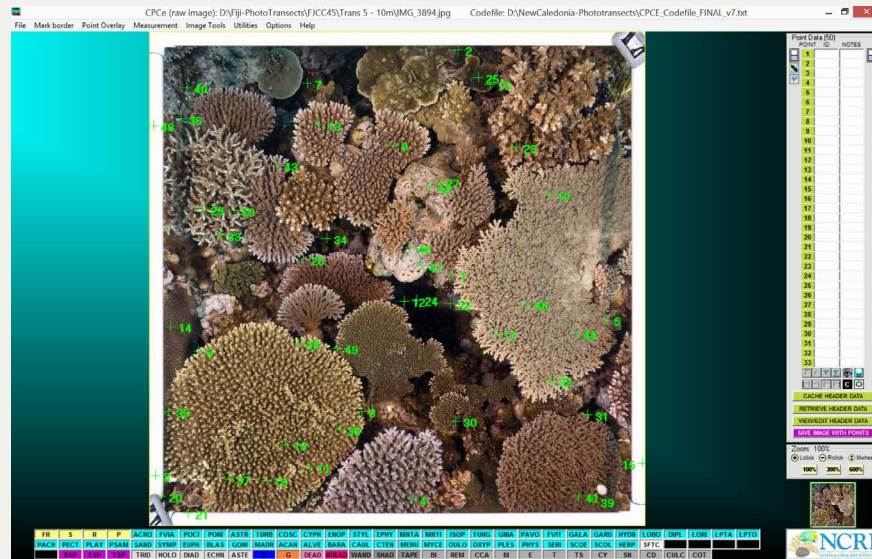


Figure 8

EXAMPLE OF A PHOTOGRAPHED QUADRAT IMPORTED INTO CORAL POINT COUNT WITH EXCEL EXTENSIONS (CPCE) SOFTWARE, WITH RANDOMLY PLACED POINTS FOR IDENTIFICATION. FIFTY RANDOM POINTS ARE OVERLAID ON EACH PHOTO QUADRAT AND SUBSTRATE TYPE AND LIVE COVER CLASSIFICATION ARE IDENTIFIED FOR EACH POINT.



3.2

b

FISH ASSESSMENTS

Reef fish surveys in the Caribbean were conducted following the AGRRA survey methodology where key indicator species were counted. Fish size and count data were collected along 30 m x 2 m belt transects, where fish size was estimated to the nearest 5 cm using a T-bar. The assessment focused on 88 species of ecologically, commercially, and recreationally important fish, but surveys recorded a total of 170 species in the assessment. Mean total density and mean total biomass were calculated among transects for each site.

In the Pacific and Indian Oceans, survey methods were similar to AGRRA, and transects covered depths between 1 to 22 m, but most of the surveys were between 5 and 20 m depth (Figure 9). Transects were deployed at deep (>11 m) and shallow (<10 m) sections of the reefs, as allowed by the morphology of the survey stations. Where possible, at least two deep and two shallow transects were conducted by divers at each site. The fish assemblages at

each survey station were surveyed following a fish visual census technique modified from the survey principles described by English et al. (1994)³⁷. The diver identified and counted fish along a 30 m x 4 m transect for 10 to 15 minutes.

Fish assemblages were characterized in terms of species richness, abundance, and standing stock biomass. Fish were identified to species level, whenever possible, with the aid of photographic fish guides³⁸⁻⁴¹. The abundance of each species of a particular size was estimated by actual counts or by cluster in the case of a school of fish. The biomass of each species was then computed using the formula $W=aLb$ where W is the weight in grams, L is the length of the fish in centimeters, and a and b are the species-specific growth constants derived from the length-weight relationships⁴²⁻⁴⁶. Abundance and biomass data were then calculated and represented as density by number of individuals per 100 m² and biomass by kg per 100 m².

The counted fish were also attributed to either feeding guild (herbivore, piscivore, or invertivore), as was the case in the Caribbean using AGRRA surveys, or trophic-level categories, based on diet by species, as was the case in the Pacific and Indian Oceans⁴⁵. The relationship between trophic levels and feeding habits is not strictly straightforward nor well defined, because of wide overlaps in the food items consumed by different species⁴⁷. Therefore, the trophic levels under which a specific species is classified may be considered elastic and representative of the mean of its diet items.

Trophic levels were expressed numerically and broadly represented herbivores (2.0-2.4), corallivores (2.5-2.9), planktivores (3.0-3.4), benthic carnivores (3.5-3.9), and piscivores (4.0-4.5)⁴⁸. By analyzing the fish communities using trophic levels, we strived to understand the community structures and determine how fishing pressures might be affecting the reef fish populations. Fish

in trophic levels 2.0-2.5 and 2.5-3.0 are typically small and are not considered important to local fisheries⁴⁹. Fish that are classified in trophic levels 2.0-3.0 are usually important indicator species that contribute to the health of the reef by providing such services as cropping algal growth that otherwise would impede the settlement of juvenile corals^{50,51}. These fish include damselfish, tangs, surgeonfish, butterflyfish, and a few small-bodied parrotfish. Fish in trophic levels 3.0-3.5 and 3.5-4.0 include larger-bodied herbivores, planktivores, omnivores, or carnivores that feed on small benthic invertebrates. Fish classified in these ranges include wrasses, some species of butterflyfish, damselfish, hogfish, goatfish, snappers, and triggerfish. Fish in trophic levels 4.0-4.5 are typically considered top predators and prey on finfish of the lower trophic levels. These predatory fish include large wrasse, grouper, hawkfish, snapper, goatfish, and sharks. The majority of the fish important to local fisheries are found in trophic levels 3.5-4.0 and 4.0-4.5^{49,52}.

Figure 9

A SCIENTIFIC SCUBA DIVER RECORDS FISH ALONG A TRANSECT LINE. SCIENTIST RECORDS FISH OBSERVED ALONG A 30 M × 4 M TRANSECT OVER A 10-15 MINUTE PERIOD.





GLOBAL REEF EXPEDITION

4.0

RESULTS



RESULTS

4.0

FINDINGS FROM THE GLOBAL REEF EXPEDITION

The findings from the Global Reef Expedition highlight both expected and some unexpected ecological trends around the world. The Caribbean reefs, while showing similar trends among themselves, presented very different benthic assemblages when compared to the rest of the regions surveyed. Within the Eastern Pacific, the Galapagos Islands distinguished themselves as a unique region that didn't follow traditional ecological trends in both the benthic and fish assemblages.

Fine-scale analysis of the benthic and fish communities for each country can be found in the [Global Reef Expedition final country reports](#) previously published by the KSLOF⁵³⁻⁶⁷. These reports provide detailed information, oftentimes to the site level, about the reefs from each country surveyed on the GRE. Additionally, detailed habitat and bathymetry maps can be found on the [KSLOF Map Portal](#). These products can be interrogated and provide highly accurate maps of nearshore marine habitats. While a fine-scale analysis is important for local conservation efforts, understanding global trends will be key to facilitating a global initiative to help combat the coral reef crisis currently plaguing the world. The findings of this report are broad-scale and compare country-wide data to better understand global trends of the world's reefs.

4.1

SAUDI ARABIAN RED SEA COASTLINE

Five regions of the Saudi Arabian Red Sea (SARS) coastline were mapped and surveyed between 2006 and 2009. The Farasan Islands (2006), Ras Al-Qasabah (2007), Al Wajh (2008), Yanbu (2008), and the Farasan Banks (2009) were selected for their complexity of marine habitats and presence of extensive, unique offshore reef systems. These reefs also generally experienced low human use and impact, and presented an excellent opportunity to assess the unique habitats and biodiversity found in the region.

4.1

a

MAPPING SAUDI ARABIAN RED SEA MARINE HABITATS

The mapping expedition to the SARS was the most extensive, and the first of its kind to ever occur in this region of the world. The results were published in the first-ever [atlas](#) of the coral reef habitats in the Saudi Arabian Red Sea²⁸. Using satellite and aircraft data, approximately 32,000 km² of shallow-water bathymetry and habitats were mapped across the five regions visited²⁹. These maps include 15 unique marine habitats from the shoreline to approximately 100 km offshore that were not seen in other parts of the world. The maps produced from this mission have been used in multiple studies to help develop novel methodology that uses remote sensing to identify areas of resilience and model live coral cover in the Red Sea^{28,68-75}.

4.1

b BENTHIC COMPOSITION OF SAUDI ARABIAN RED SEA CORAL REEFS

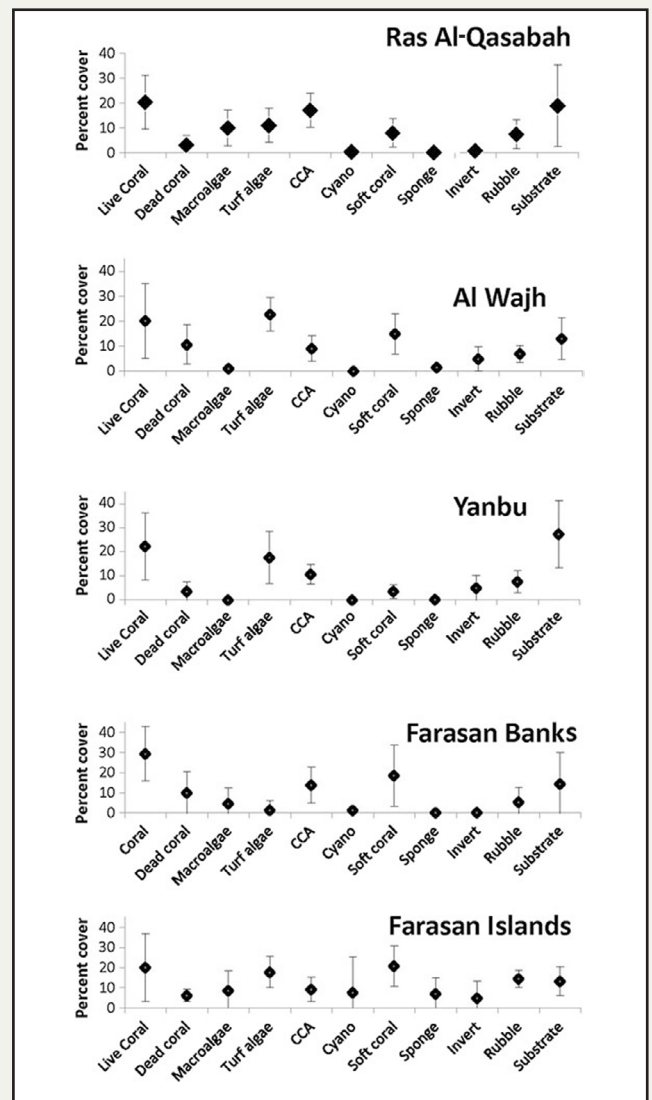
The northern-central SARS (Ras Al-Qasabah, Al Wajh, and Yanbu) had a high diversity of reef and coastal habitat types. These included large areas of coastal marshes, seagrasses, algal flats, sandy lagoons, and mangroves. The mainland and islands had fringing coral reefs and offshore patch reefs and barrier reefs. The southern area, including the Farasan Banks and Farasan Islands, had a wide, shallow shelf and turbid waters with high sedimentation in nearshore areas.

The Farasan Banks had the highest mean live coral cover ($29.4 \pm 13.4\%$ S.E.), and the lowest was found in Ras Al-Qasabah ($20.4 \pm 10.4\%$ S.E.) (Figure 10)⁷⁶. Dead coral was commonly seen across sites and accounted for over 10% of the benthos. It appeared that most reefs throughout the region had experienced several acute past disturbances, such as possible bleaching events and disease and COTS outbreaks, that were responsible for extensive coral losses, and large portions of the entire reef track were devoid of adult colonies. The coral communities showed signs of recovery, with numerous coral recruits observed, and small colonies of live coral dominated the reefs.

Macroalgal cover was high in shallow locations in the Farasan Islands, nearshore reef flat communities in the Farasan Banks, and parts of Ras Al-Qasabah. Turf and CCA were the dominant algae found in Al Wajh and Yanbu. In all locations, benthic invertebrates (predominantly *Xenia*, 14-20% cover) colonized substrate and dead coral skeletons, particularly in degraded areas on deeper reefs.

Figure 10

BENTHIC COVER OF FIVE REGIONS SURVEYED ALONG THE SAUDI ARABIAN RED SEA COASTLINE. BENTHIC COVER WAS RECORDED AS LIVE CORAL, DEAD CORAL, ALGAL FUNCTIONAL GROUPS (MACROALGAE, TURF ALGAE, CRUSTOSE CORALLINE ALGAE, AND CYANOBACTERIA), BENTHIC INVERTEBRATES (SOFT CORALS, SPONGES, AND OTHER SESSILE INVERTEBRATES POOLED), RUBBLE, AND UNCOLONIZED SUBSTRATE (SAND, PAVEMENT). ERROR BARS INDICATE STANDARD ERROR. FIGURE REPRODUCED WITH PERMISSION FROM BRUCKNER AND DEMPSEY (2015); COPYRIGHT SPRINGER-VERLAG BERLIN HEIDELBERG 2015; DOI 10.1007/978-3-662-45201-1_27.



RESULTS

4.1

c

REEF FISH ASSEMBLAGES OF SAUDI ARABIAN RED SEA CORAL REEFS

In general, most SARS reefs had a relatively high diversity of fishes, with representatives of most functional groups present. However, some species appeared to be depleted, including many of the top predators like sharks and large groupers. This was apparent in both a reduced number of fishes within transects and the presence of primarily juveniles and young adults of a small size. Of the fish present, few had achieved their maximum size. Coral feeders, including butterflyfish, angelfish, and filefish/pufferfish, were common on reefs with moderate to high

coral cover, while they were absent from several of the more degraded sites. Certain planktivores, especially fusiliers, were often abundant in offshore locations adjacent to a steep slope, which may be indicative of upwelling. Herbivores, such as rabbitfish and surgeonfish, were usually most common on the reef flats, especially in the Farasan Banks and Farasan Islands where algal abundances were higher. In some cases, parrotfish were the largest-sized fish recorded in reef surveys⁷⁷.

4.1

d

MODELING RESILIENCE IN THE RED SEA

Measuring reef resilience was an important objective on the Red Sea research mission. Rowlands et al. (2012) used field data, satellite imagery, and remote sensing to model resilience of the Saudi Arabian Red Sea coastline⁷⁰. To measure resilience, they used live coral abundance, framework abundance, water depth variability, fishing pressure, industrial development, and temperature stress as measures of stress to the environment. Using the high-resolution habitat maps, they overlaid a 1 km x 1 km geographic information system (GIS) grid across the map and used the field-collected data to develop multiple resilience indices across the multiple habitats. The indices they developed included a coral abundance index, framework abundance index, depth variability index, fishing intensity index, development index, thermal stress index, and remote-sensed resilience index within each of the 1 km GIS grid cells.

Ultimately, Rowlands et al. (2012) found that the reefs of the Farasan Banks had the highest overall resilience, which reflects a low level of combined stress and a reef landscape that promotes persistence of coral communities. The fishing pressure index was the

greatest in the waters offshore of Jizan and the Farasan Islands, which can be attributed to the large industrial and traditional fishing fleets that are moored in the area. Yanbu had the lowest median combined resilience index, which may be attributed to the high fishing pressure on these reefs. Across all locations, Rowlands et al. (2012) notes that many factors, such as reef framework, coral abundance, thermal stress, fishing, and coastal development, have different levels of impact and contribute to the variability seen in the resilience of the reefs throughout Saudi Arabia. Studies like this provide critical insight into reef resilience that can be applied by Red Sea marine managers in the establishment of MPAs and management plans.

Measuring reef resilience was an important objective on the Red Sea research mission.

4.2

CARIBBEAN

The Global Reef Expedition surveyed Caribbean reefs in The Bahamas (2011), St. Kitts and Nevis (2011), Jamaica (2012), Navassa (2012), and Colombia (2012). These reefs had some of the lowest coral cover, fish biomass, and fish density recorded on the GRE. Macroalgae dominated the substrate in all locations; however, there was no significant correlation between biomass of herbivorous fish and macroalgal cover.

4.2

a

MAPPING THE CARIBBEAN

The Caribbean shallow marine habitats were mapped and surveyed on the Global Reef Expedition in 2011-2012. KSLOF developed high-resolution habitat maps of The Bahamas and Colombia. The Bahamian maps were published in the [Atlas of Shallow Marine Habitats of Cay Sal Bank, Great Inagua, Little Inagua, and Hogsty Reef, Bahamas](#)³⁰. Combined, a total of nearly 9,000 km² were mapped in these two countries. Of the 26 total in these maps, 22 were unique to this region of the

world. The Bahamas was home to the most seagrass habitats mapped on the GRE, covering over 500 km². Colombia had large *Acropora palmata* patch reef and framework habitats mapped. *Acropora palmata* is a reef-building, highly threatened species of coral, so knowing the location and extent of where it is dominant can help with monitoring and preserving the species. These high-resolution habitat maps have been referenced when developing conservation and management plans in The Bahamas.

4.2

b

CARIBBEAN REEFS BENTHIC ASSEMBLAGE

To measure the condition of the benthic communities in the Caribbean, KSLOF scientists and partners conducted benthic surveys following AGRRA sampling protocol. All survey data from the regions visited on the GRE can be found in the AGRRA database³⁴. Caribbean reefs historically have lower coral diversity and live coral cover than reefs in the rest of the world. These reefs are isolated from the Pacific and Indian Ocean, and evolution has allowed endemic coral and fish species to develop and prosper here. The Caribbean reefs, overall, had low live coral cover. The Bahamas (8.3±5%) and Navassa (8.6±5%) each had an average of less than 9% live coral cover, the lowest in the Caribbean, and

St. Kitts and Nevis and Colombia had the highest mean (±S.D.) coral cover, 14±5% and 13±7%, respectively.

Across the Caribbean, the number of coral genera observed averaged between 3-4.5 per transects out of 15 total genera recorded. *Siderastrea*, *Porites*, *Orbicella*, and *Agaricia* were the dominant coral genera in every country surveyed in the Caribbean. Coral genera diversity was measured for each country using the Simpson Diversity Index. **Table 3** shows the coral diversity of each country surveyed in the Caribbean.

RESULTS

Algae groups recorded on the benthos include crustose coralline algae (CCA), erect calcareous algae (such as *Halimeda*), turf, fleshy macroalgae, and turf mixed with algae (Box 1). Overall, macroalgae was the dominant algal group of the benthos (Figure 11) in the Caribbean. Examples of macroalgae recorded on the survey transects include algae from the genera *Caulerpa*, *Sargassum*, *Lobophora*, *Padina*, *Peyssonnelia*, *Microdictyon*, and *Dictyota*. These algae are common throughout the Caribbean and have become more abundant due to the decline in herbivorous grazers and coral cover over the past 30 years. Macroalgae was most abundant in The Bahamas (49±22% cover) and Navassa (44±12% cover). Jamaica had the lowest macroalgal cover (22±8%) and the most crustose coralline algae (CCA) observed (18±7%) in the Caribbean (Figure 11). The mean percentage of algae observed in the Caribbean was 65% (±14% S.D.), with Colombia having the lowest (55±11% S.D.) and The Bahamas having the highest (70±15% S.D.) mean percentages recorded.

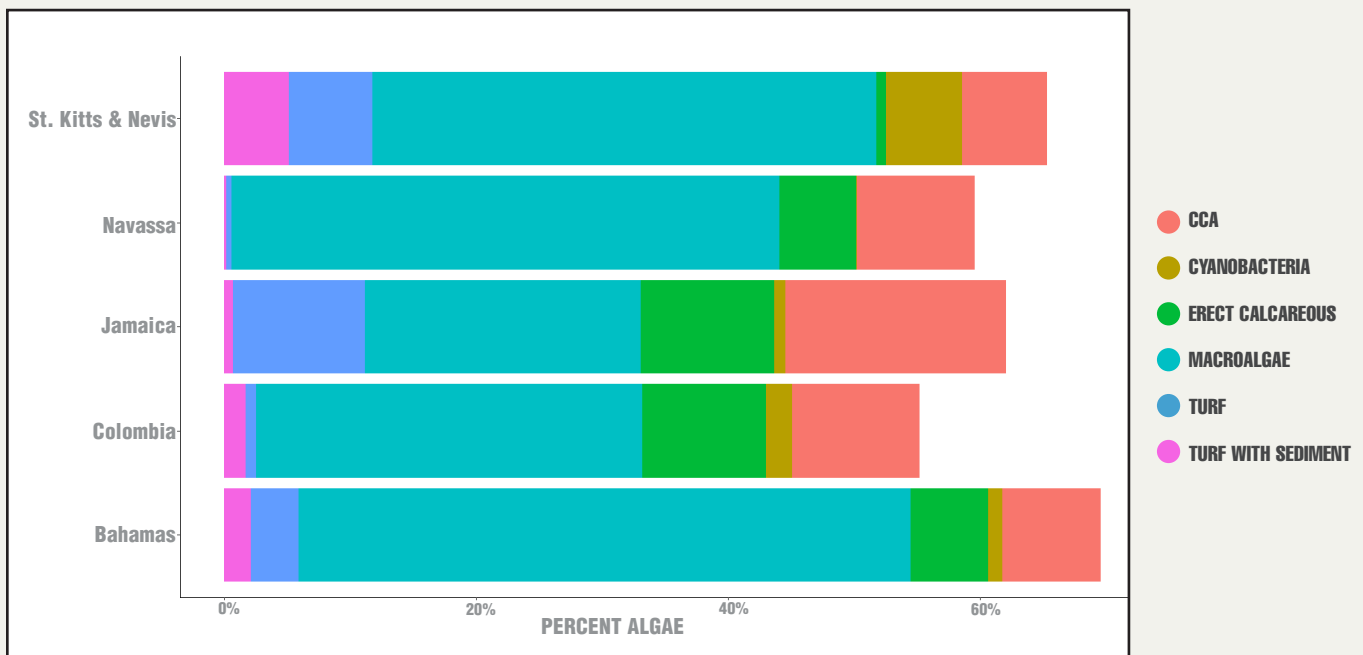
Table 3

CORAL DIVERSITY FOR LOCATIONS SURVEYED IN THE CARIBBEAN WAS CALCULATED USING THE SIMPSON DIVERSITY INDEX. CORAL DIVERSITY WAS MEASURED USING CORAL GENERA CLASSIFICATIONS AS THE LOWEST TAXONOMIC IDENTIFICATION. CORAL GENERA DIVERSITY MEASURES WERE NORMALIZED ACROSS THE CARIBBEAN COUNTRIES SURVEYED. A VALUE CLOSE TO ZERO INDICATES LOW DIVERSITY AND A VALUE CLOSE TO ONE INDICATES HIGH DIVERSITY.

COUNTRY	SIMPSON DIVERSITY INDEX
Bahamas	0.83
Colombia	0.79
Jamaica	0.84
Navassa	0.86
St. Kitts & Nevis	0.83

Figure 11

MEAN PERCENTAGE OF ALGAE GROUPS SURVEYED IN THE CARIBBEAN. ALGAE GROUPS RECORDED ON THE BENTHOS WERE CRUSTOSE CORALLINE ALGAE, CYANOBACTERIA, ERECT CALCAREOUS ALGAE, MACROALGAE, TURF, AND TURF MIXED WITH SEDIMENT. IN ALL LOCATIONS, MACROALGAE WAS THE DOMINANT ALGAE GROUP RECORDED.



4.2

C

CARIBBEAN REEF FISH ASSEMBLAGE

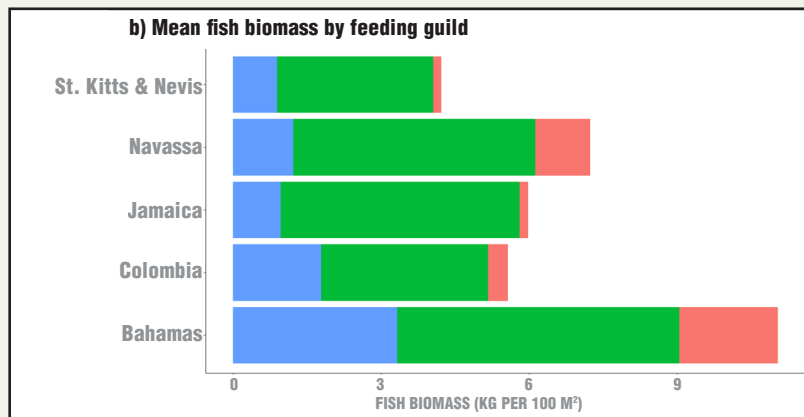
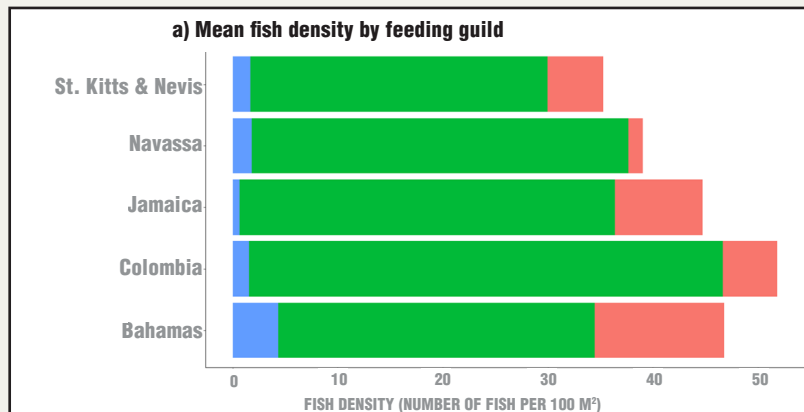
Reef fish biomass and density were measured to assess the status of the Caribbean reef fish populations in each of the locations surveyed. The reef fish were grouped into feeding guilds: piscivores, invertivores, and herbivores. This allowed us to understand the community dynamics of the reef fish and assess the impact these different feeding guilds may be having on the benthic communities. In all locations, total fish density and biomass were low. Herbivores were the overwhelmingly dominant fish group in both density and biomass (Figure 12a and b). Overall, the total mean fish biomass (\pm S.D.) for the Caribbean was 8.2 ± 7.4 kg per 100 m², and the total mean fish density was 61 ± 24 fish per 100 m². The Bahamas overall had the highest mean fish

biomass (11 ± 9.5 kg per 100 m²) and the second-highest mean fish density (61 ± 25 fish per 100 m²). The Bahamas also had nearly double the mean fish biomass of invertivores and piscivores (Figure 12b) than other locations in the Caribbean. Colombia had the highest total mean fish density (77 ± 19 kg per 100 m²); however, the country also had the second-lowest mean fish biomass (5.6 ± 2.8 kg per 100 m²), indicating the fish observed were small but abundant. St. Kitts and Nevis had the lowest total fish biomass (4.2 ± 3.3 kg per 100 m²) and fish density (45 ± 13 fish per 100 m²), and despite poor fish populations, this country had the highest average live coral cover ($14\pm 5\%$ S.D.) of all the Caribbean countries surveyed.

Figure 12

FISH COMMUNITY STRUCTURE IN CARIBBEAN LOCATIONS SURVEYED ON THE GRE. (A) MEAN FISH DENSITY (NUMBER OF FISH PER 100 M²); AND (B) MEAN FISH BIOMASS (KG PER 100 M²) OF FISH ARE GROUPED BY FEEDING GUILD (PISCIVORE, HERBIVORE, AND INVERTIVORE) FOR EACH LOCATION SURVEYED IN THE CARIBBEAN. HERBIVOROUS FISH ACCOUNTED FOR THE HIGHEST DENSITY AND BIOMASS IN ALL CARIBBEAN LOCATIONS.

- PISCIVORE
- HERBIVORE
- INVERTIVORE



RESULTS

4.2

d

ARE HERBIVOROUS FISH IMPACTING THE BENTHIC COMMUNITY?

To better understand the relationship between coral, algae, and fish, multiple regression analyses were performed, including more fine-scale correlations between fish feeding guilds (piscivore, herbivore, and invertivore) and common algae groups (macroalgae, CCA, turf). The goal was to identify the relationship between coral and macroalgae as a way to identify a potential for a phase shift from coral to algae, and to better understand the role of fish in controlling this phase shift. The percentage of recorded live coral cover across all Caribbean countries compared to algae groups showed a strong negative relationship between macroalgae and live coral cover ($R=-0.42$). As expected, as live coral cover increased, the total

percentage of macroalgae decreased (Figure 13). There was no significant relationship between coral cover and other algae groups (CCA, turf). Navassa ($R=-0.68$, $p=0.005$) and The Bahamas ($R=-0.55$, $p=1.5e^{-7}$) showed the strongest relationship between live coral and macroalgae. St. Kitts and Nevis and Jamaica both showed no significant relationship between these two variables (Figure 14). The Caribbean-wide trend was likely driven by the strong correlation in The Bahamas and Navassa, as St. Kitts and Nevis and Jamaica both had a higher percentage of algae in other groups (Figure 11). This might suggest Jamaica and St. Kitts and Nevis reefs may be recovering from a previous phase shift from coral to macroalgae.

Figure 13

SCATTER PLOT AND REGRESSION LINE COMPARING PERCENT LIVE CORAL COVER (X-AXIS) AND PERCENT MACROALGAE COVER (Y-AXIS) IN CARIBBEAN LOCATIONS SURVEYED ON THE GRE. MEAN PERCENT CORAL AND MEAN PERCENT MACROALGAE MEASURES FOR SITES SURVEYED ACROSS ALL CARIBBEAN LOCATIONS ($N=168$) WERE COMPARED TO BETTER IDENTIFY CARIBBEAN CORRELATION BETWEEN THESE TWO BENTHIC METRICS. THERE IS A STRONG NEGATIVE CORRELATION BETWEEN LIVE CORAL COVER AND PERCENT MACROALGAE ($R=-0.42$, $P < 0.05$). REGRESSION LINE AND VARIANCE ARE SHOWN.

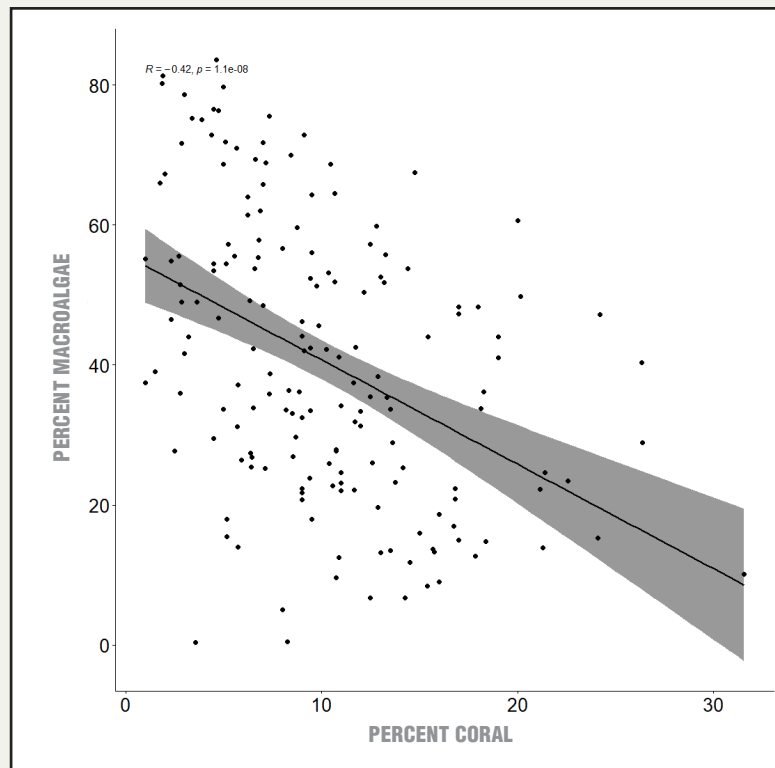
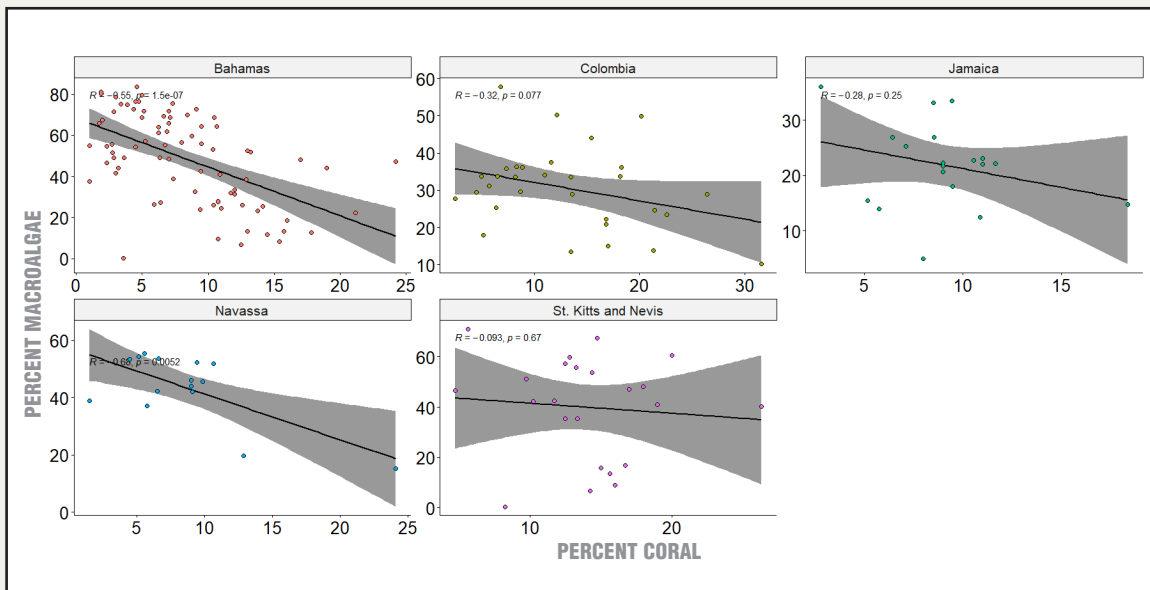


Figure 14

REGRESSION ANALYSIS OF PERCENT CORAL COVER (X-AXIS) AND PERCENT MACROALGAE COVER OF CARIBBEAN LOCATIONS SURVEYED. THREE OF THE FIVE LOCATIONS SURVEYED HAD A SIGNIFICANT CORRELATION BETWEEN THESE TWO BENTHIC METRICS AND THESE LOCATIONS (THE BAHAMAS, COLOMBIA, AND NAVASSA) AND ARE LIKELY DRIVING CARIBBEAN-WIDE TRENDS. SCALES FOR EACH GRAPH ARE DIFFERENT; REGRESSION LINE AND VARIANCE FOR EACH LOCATION SHOWN.



When looking at the correlation between fish biomass and the benthic organisms, there was a weak negative relationship with herbivorous fish density ($R=-0.26$) and biomass ($R=-0.28$) and macroalgal cover. This negative relationship indicates that the herbivorous fish may be helping to control the overall macroalgal cover; however, the relationship varied by country (Figure 15a and b). The strongest correlations between herbivorous fish biomass and percent macroalgal cover were seen in The Bahamas ($R=-0.46$, $p=1.8e^{-5}$) and Navassa ($R=-0.87$, $p=2.7e^{-5}$) (Figure 15b). These strong correlations can be attributed to the higher percentage of macroalgae and herbivorous fish observed in these countries.

There was no relationship between the total fish density, total fish biomass, and coral cover in the Caribbean. When further exploring the fish biomass and density by feeding guild, there was still no relationship with percent coral cover and fish.

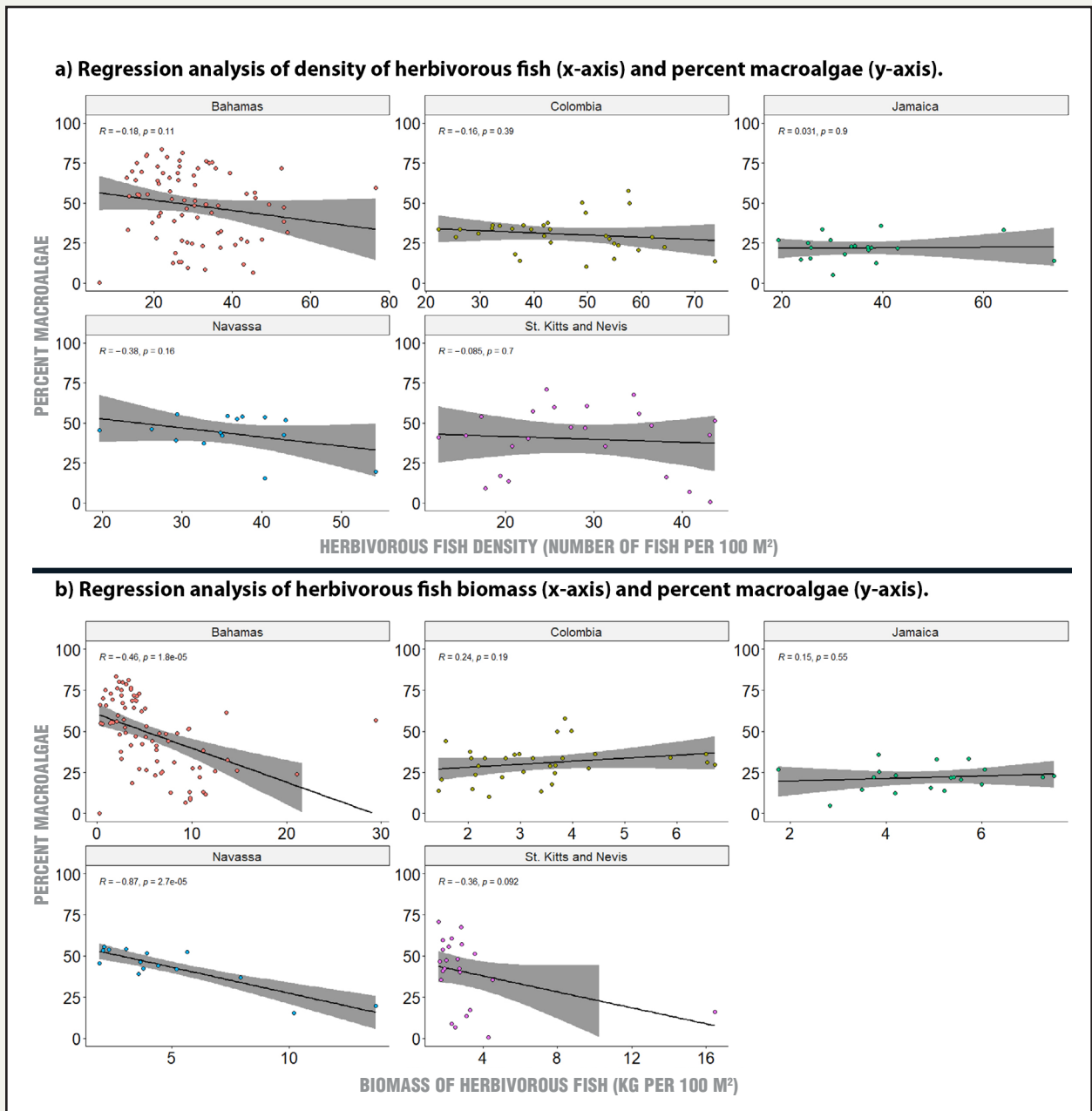
Generally, other studies^{51,78,79} have shown that fish biomass and coral cover have a strong correlation on a reef. It is likely that the fish biomass, density, and live coral cover across the Caribbean were all too low to show a meaningful relationship.

There was low fish biomass, density, and coral cover across the Caribbean.

RESULTS

Figure 15

REGRESSION ANALYSIS OF HERBIVOROUS FISH (A) DENSITY (NUMBER OF FISH PER 100 M²) AND (B) BIOMASS (KG PER 100 M²) AGAINST PERCENT MACROALGAE IN CARIBBEAN COUNTRIES SURVEYED ON THE GRE. THE CORRELATION BETWEEN HERBIVOROUS FISH DENSITY AND MACROALGAL COVER SHOWED NO SIGNIFICANT CORRELATION ACROSS ALL LOCATIONS. THERE WAS A NEGATIVE CORRELATION BETWEEN FISH BIOMASS AND MACROALGAL COVER IN THE BAHAMAS, NAVASSA, AND ST. KITTS AND NEVIS. GRAPHS SHOW FISH DENSITY AND BIOMASS ON THE X-AXIS, AND PERCENT MACROALGAE ON Y-AXIS. X-AXIS SCALES ARE VARIABLE.



4.3

PACIFIC AND INDIAN OCEANS

Most of the reefs surveyed on the GRE were in the Pacific and Indian Oceans. The locations surveyed included the Galapagos Islands (2012), four island groups in French Polynesia including the Society Archipelago (2012), Tuamotu Archipelago (2012), Gambier Archipelago (2013), and the Austral Archipelago (2013), the Cook Islands (2013), Fiji (2013), Kingdom of Tonga (2013), New Caledonia (2013), Northern Great Barrier Reef (2014), Solomon Islands (2014), Republic of Palau (2015), and Chagos Archipelago (2015). The geographic expanse of these reefs allowed the GRE researchers to encounter some of the most pristine reefs with exceptionally high coral cover, fish biomass and density, as well as some reefs struggling to recover from local acute disturbances.

4.3

a

MAPPING REEFS IN THE PACIFIC AND INDIAN OCEANS

The KSLOF fellows mapped nearly all locations visited except for Palau and the Northern Great Barrier Reef, as these locations already had high-resolution habitat maps of their reefs. Over 24,000 km² were mapped in the Pacific and Indian Oceans, and a total of 61 unique shallow water habitats were identified, with most of the areas mapped surrounding atolls. Morphologically, nearly all the atoll reef systems consisted of traditional fore reef, backreef, and lagoonal habitats. The habitats

identified included coral-dominated, macroalgal-dominated, and sediment-dominated habitats among the different areas of the reef system. The Galapagos Islands were unique, as they did not have the same geomorphology as seen in other regions of the Pacific Ocean. Instead, marine habitats such as basalt boulders and basalt rocks were common in this island group covering 61.6 km² and were unseen in other mapped regions of the GRE.

The Global Reef Expedition mapped over **24,000 km²** of **marine habitats** in the **Pacific** and **Indian Oceans**.

RESULTS

4.3

b

PACIFIC AND INDIAN OCEANS BENTHIC ASSEMBLAGE

The benthic communities of the Pacific and Indian Oceans were assessed to provide insight into the expanse of the coral reef crisis and to determine the status of some of the most remote reefs. The mean (\pm S.D.) live coral cover in the Pacific Ocean basin was $36\pm 17\%$. The reefs of the Gambier Archipelago in French Polynesia had the highest average live coral cover ($52\pm 13\%$), followed by Palau with $49\pm 16\%$ (Figure 16). The reefs with the lowest mean live coral cover were found in the Society Archipelago, French Polynesia, and the Galapagos Islands, both with 21% live coral recorded. As previously described in the French Polynesia Final Report⁵⁷, the reefs of the Society Archipelago had recently experienced a COTS outbreak that severely reduced the coral cover in this area⁸⁰. The Chagos Archipelago, the only region surveyed in the Indian Ocean, had a mean coral cover of $40\pm 16\%$.

A total of 74 coral genera were documented across the countries surveyed in the Pacific and Indian Oceans on the GRE. The mean number of coral genera recorded in the combined Pacific and Indian Ocean data was 6.6 genera per 10 m transect. The coral richness seen on these reefs generally decreased as distance away from the Coral Triangle increased. The Galapagos Islands, the location farthest away from the Coral Triangle, had only four coral genera recorded and a mean of 2.2 ± 0.7 coral genera per 10 m transect (Figure 17). Northern Great Barrier Reef (8.7 ± 3.4 coral genera per 10 m), Tonga (8.6 ± 3.3 coral genera per 10 m), and Palau (8.5 ± 3.7 coral genera per 10 m) had the highest mean coral genera recorded and are found near the Coral Triangle. The coral genera diversity of all countries surveyed in the Pacific and Indian Oceans can be found in Table 4.

Figure 16

BOXPLOTS IN ASCENDING ORDER OF MEAN PERCENT CORAL COVER OF LOCATIONS SURVEYED IN THE CARIBBEAN, PACIFIC AND INDIAN OCEAN. THE BOXPLOTS WERE MADE USING SITE MEAN CORAL COVER MEASURED AT EACH LOCATION. THE HIGHEST CORAL COVER WAS FOUND IN THE GAMBIER ARCHIPELAGO, FRENCH POLYNESIA, WITH THE CARIBBEAN REEFS ALL HAVING THE LOWEST LIVE CORAL COVER RECORDED. THE DOTS INDICATE OUTLIERS AND MEDIAN IS SHOWN BY THE CROSSBAR.

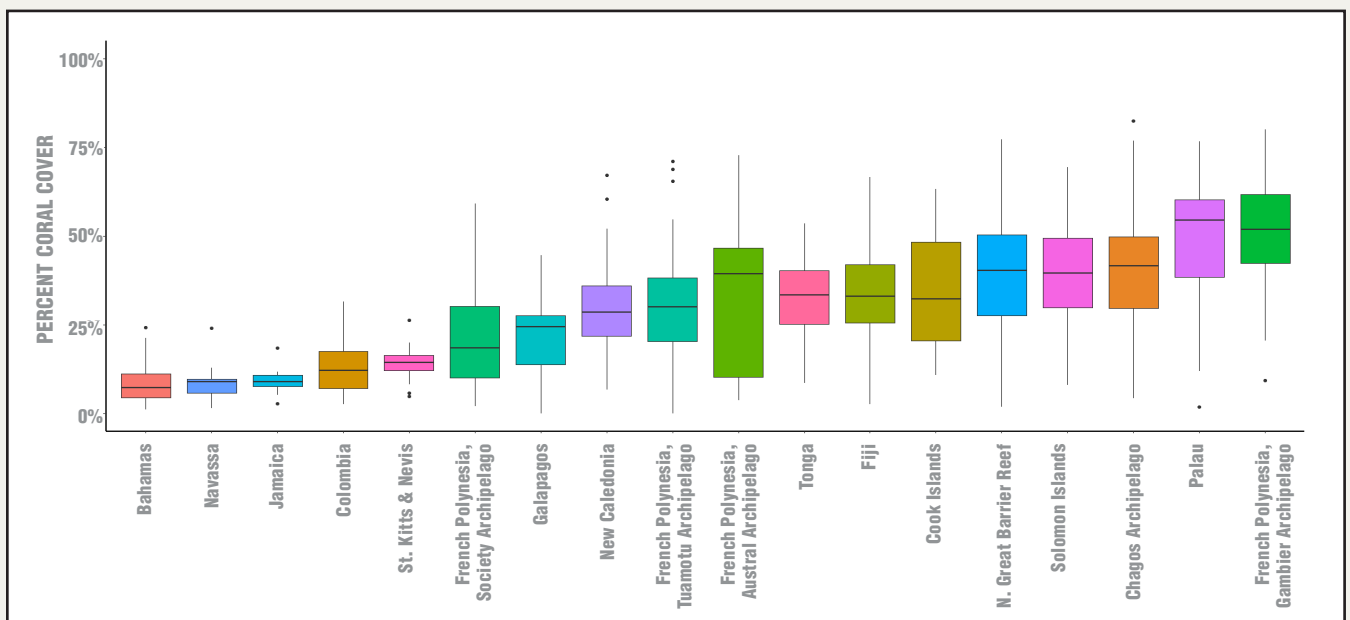


Figure 17

BOXPLOTS IN ASCENDING ORDER OF MEAN NUMBER OF CORAL GENERA OBSERVED PER 10 M IN LOCATIONS SURVEYED IN THE CARIBBEAN, PACIFIC AND INDIAN OCEANS. SITE MEAN NUMBER OF CORAL GENERA MEASURED PER 10 M TRANSECT MEASURED AT EACH LOCATION. CORAL GENERA RICHNESS WAS HIGHEST IN AREAS LOCATED GEOGRAPHICALLY CLOSE TO THE CORAL TRIANGLE. THE DOTS INDICATE OUTLIERS AND MEDIAN IS SHOWN BY THE CROSSBAR.

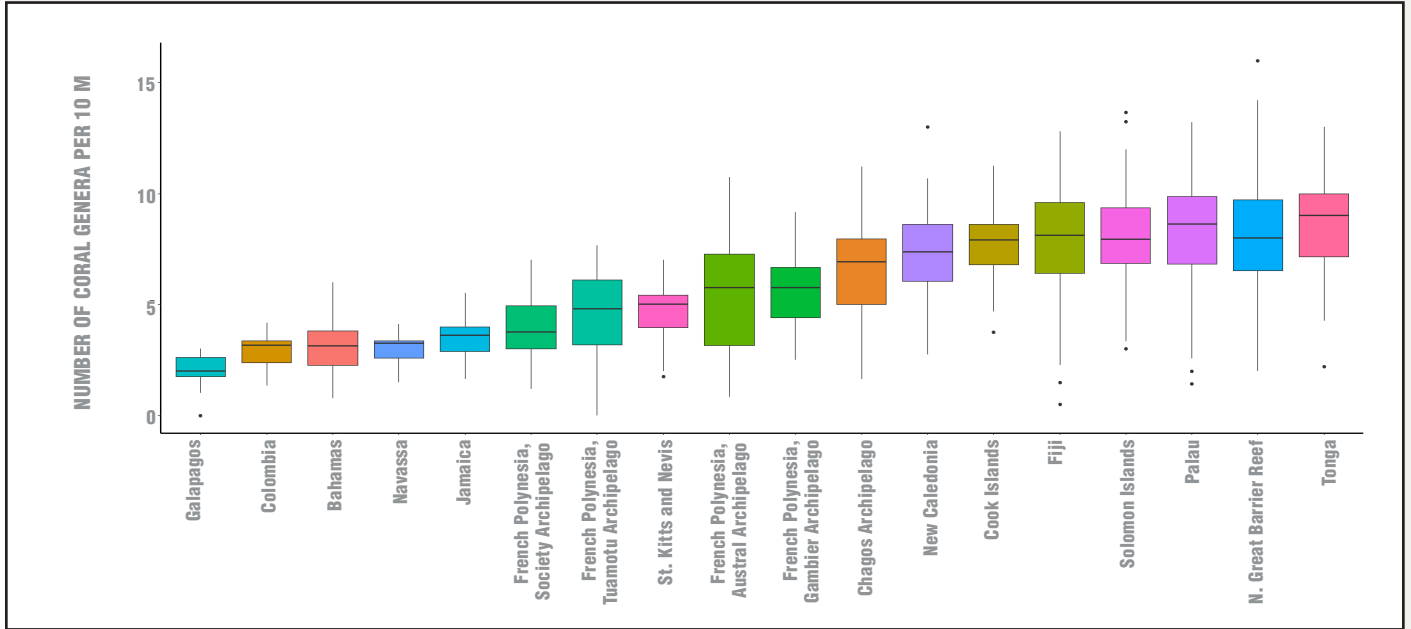


Table 4

CORAL DIVERSITY FOR LOCATIONS SURVEYED IN THE PACIFIC AND INDIAN OCEANS WAS CALCULATED USING THE SIMPSON DIVERSITY INDEX. CORAL DIVERSITY WAS MEASURED USING CORAL GENERA CLASSIFICATIONS AS THE LOWEST TAXONOMIC IDENTIFICATION. CORAL GENERA DIVERSITY MEASURES WERE NORMALIZED ACROSS THE PACIFIC AND INDIAN OCEANS LOCATIONS SURVEYED. A VALUE CLOSE TO ZERO INDICATES LOW DIVERSITY AND A VALUE CLOSE TO ONE INDICATES HIGH DIVERSITY.

COUNTRY	SIMPSON DIVERSITY INDEX
Chagos Archipelago	0.83
Cook Islands	0.90
French Polynesia- Austral Archipelago	0.88
French Polynesia- Gambier Archipelago	0.79
French Polynesia- Society Archipelago	0.83
French Polynesia- Tuamotu Archipelago	0.82
Galapagos Islands	0.63
Lau Province, Fiji	0.86
New Caledonia	0.86
N. Great Barrier Reef	0.89
Palau	0.85
Solomon Islands	0.90
Tonga	0.86

RESULTS

It is worth noting that the genera richness and biodiversity calculations should not be used exclusively to assess the status of a reef. For example, many transects within the Chagos Archipelago had nearly 100% coral cover, but that coral community consisted entirely of table-forming *Acropora*. Because of the many large monospecific stands found in Chagos, the coral diversity was 0.827 and had the third-lowest mean number of genera recorded on each transect (6.6 ± 2.9 coral genera per 10 m).

The mean percentage of total algae in the Pacific and Indian Oceans was $48 \pm 18\%$ and predominantly consisted of CCA and turf algae (Figure 18). New Caledonia ($60 \pm 12\%$) and the Cook Islands ($61 \pm 15\%$) had the highest algal cover recorded, both dominated by CCA. Aitutaki, an atoll in the Cook Islands, was severely impacted by COTS prior to the time of our surveys and had overall low live coral cover, with many

dead coral colonies found. Algae had begun to colonize the dead corals, leading to a higher algal cover at this location. Although the Society Archipelago, French Polynesia, and the reefs of the Galapagos had the lowest coral cover recorded, these locations did not have the highest algae recorded (Figure 19). Instead, a high percentage of bare substrate was observed in these two areas. In the Galapagos, sand accounted for most of the bare substrate, and in the Society Archipelago, the bare substrate was due to the recent COTS outbreak and remaining dead coral that had not been colonized by other benthic organisms.

Figure 18

MEAN PERCENTAGE OF ALGAE GROUPS SURVEYED IN THE PACIFIC AND INDIAN OCEANS. ALGAE GROUPS RECORDED ON THE BENTHOS WERE CRUSTOSE CORALLINE ALGAE (CCA), CYANOBACTERIA, ERECT CALCAREOUS ALGAE, MACROALGAE, TURF, AND TURF MIXED WITH SEDIMENT. CCA AND TURF WERE THE MOST COMMON ALGAL TYPES RECORDED IN ALL LOCATIONS.

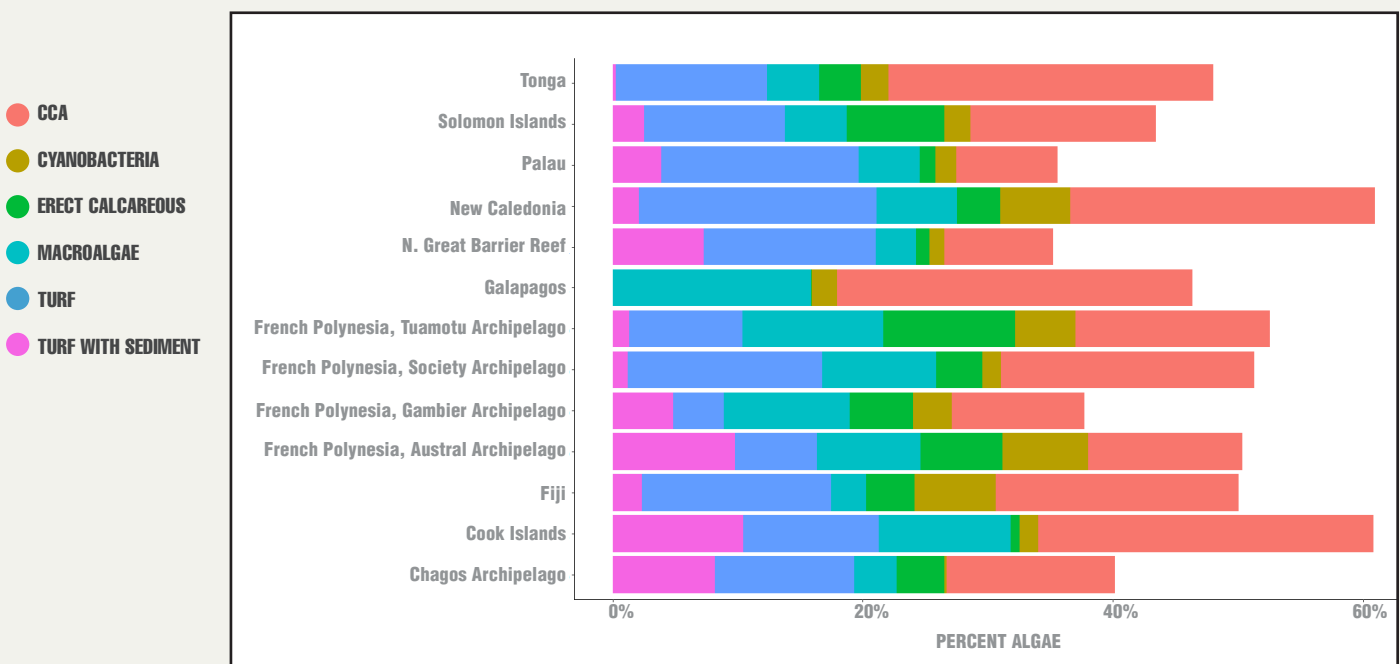
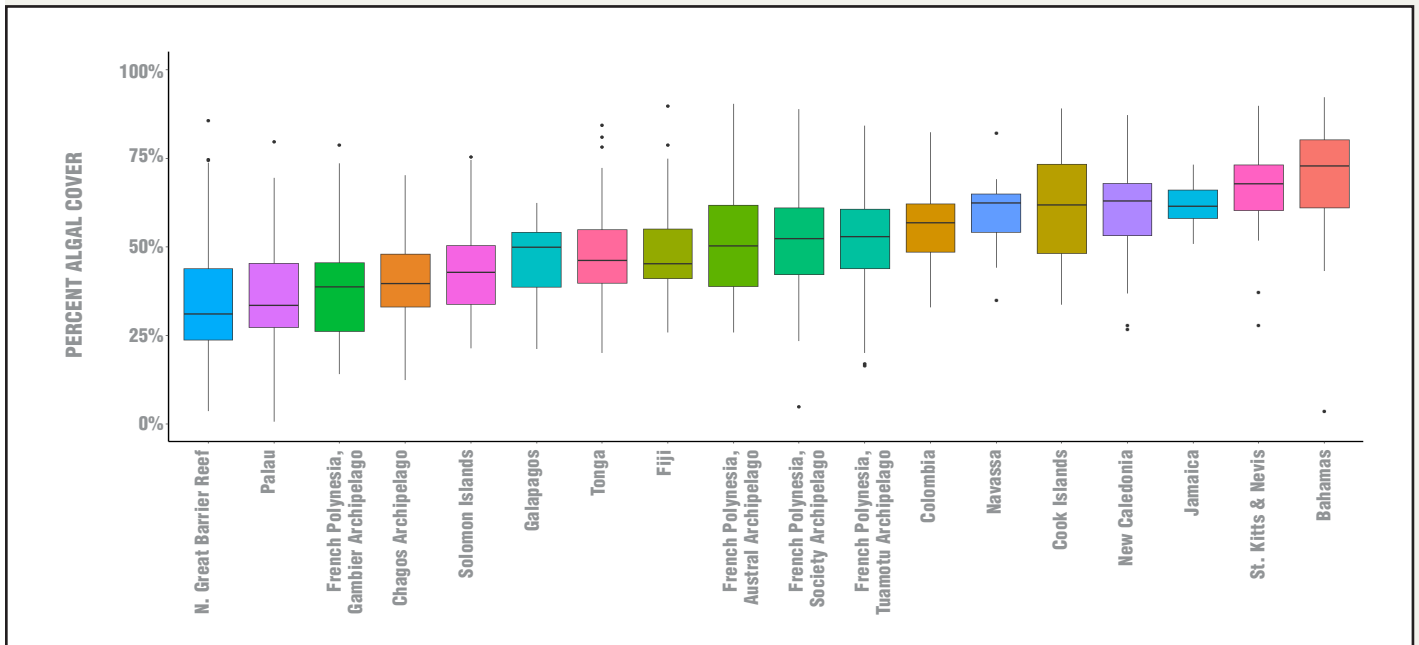


Figure 19 BOXPLOTS IN ASCENDING ORDER OF MEAN TOTAL PERCENT ALGAL COVER IN LOCATIONS SURVEYED IN THE CARIBBEAN, PACIFIC, AND INDIAN OCEANS. TOTAL PERCENT ALGAE WAS CALCULATED FROM THE SUM OF ALL ALGAE GROUPS (CCA, MACROALGAE, TURF, TURF MIXED WITH SEDIMENT, CYANOBACTERIA, AND ERECT CALCAREOUS ALGAE). ALGAL COVER WAS LOWEST IN THE N.GBR, PALAU, AND GAMBIER ARCHIPELAGO IN FRENCH POLYNESIA. THE DOTS INDICATE OUTLIERS AND MEDIAN IS SHOWN BY THE CROSSBAR.



4.3

C

PACIFIC AND INDIAN OCEANS REEF FISH ASSEMBLAGE

The combined data of the Pacific and Indian Oceans had a mean (\pm S.D.) fish density of 194 ± 116 fish per 100 m^2 and mean fish biomass of 22 ± 29 kg per 100 m^2 . The highest mean fish density (279 ± 165 fish per 100 m^2) and second-highest mean fish biomass (39 ± 48 kg per 100 m^2) was found in the Tuamotu Archipelago in French Polynesia. The reefs of the Tuamotu Archipelago had the most fish in the 2.5-2.9 and 3.0-3.4 trophic groups, and the second-highest number of fish in the highest trophic level 4.0-4.5, which includes top predators

like barracuda, groupers, and sharks (Figure 20a). The highest fish biomass (42 ± 20 kg per 100 m^2) was found in the Galapagos (Figure 20b) and can be attributed to the high density of top predators, such as sharks, recorded here. Numerous shark species were commonly seen on the reefs in the Galapagos, more than observed at any other location surveyed. Although the fish biomass was high in the Galapagos, the fish density (151 ± 85 fish per 100 m^2) fell in the midrange of all the countries visited. Tonga had alarmingly low fish density (92 ± 46 fish

RESULTS

Figure 20

FISH COMMUNITY STRUCTURE IN THE PACIFIC AND INDIAN OCEAN LOCATIONS SURVEYED ON THE GRE. (A) MEAN FISH DENSITY (NUMBER OF FISH PER 100 M²); AND (B) MEAN FISH BIOMASS (KG PER 100 M²) OF FISH ARE GROUPED BY TROPHIC LEVEL (2.0-2.4, 2.5-2.9, 3.0-3.4, 3.5-3.9, AND 4.0-4.5) FOR EACH LOCATION SURVEYED IN THE PACIFIC AND INDIAN OCEANS. MOST LOCATIONS HAD THE HIGHEST DENSITY OF FISH IN TROPHIC LEVEL 3.0-3.4 WHICH INCLUDE LARGER BODIED HERBIVORES AND PLANKTIVORES SUCH AS WRASSES, SOME SPECIES OF BUTTERFLYFISH, AND DAMSELFISH. THE TUAMOTU ARCHIPELAGO IN FRENCH POLYNESIA HAD THE HIGHEST FISH BIOMASS IN TROPHIC LEVEL 3.5-3.9 AND 4.0-4.5, WHICH IS DUE TO THE HIGH NUMBER OF SHARK AND GROUPERS OBSERVED HERE.

TROPHIC LEVEL

- 2.0-2.4
- 2.5-2.9
- 3.0-3.4
- 3.5-3.9
- 4.0-4.5



per 100 m²) and biomass (4.5±4.1 kg per 100 m²) (Figure 20a and b), the lowest in all the locations surveyed in the Pacific and Indian Oceans. Some studies suggest baseline fish biomass on reefs should be between 11 and 19 kg per 100 m², and Tonga's fish biomass was substantially below that threshold⁸¹⁻⁸³.

The fish species richness across the Pacific and Indian Oceans ranged from 15-41 species per 100 m², with a mean of 28±10 species per 100 m². Because of its inclusion in the boundary of the Coral Triangle, we expected the reefs surveyed in the Solomon Islands to

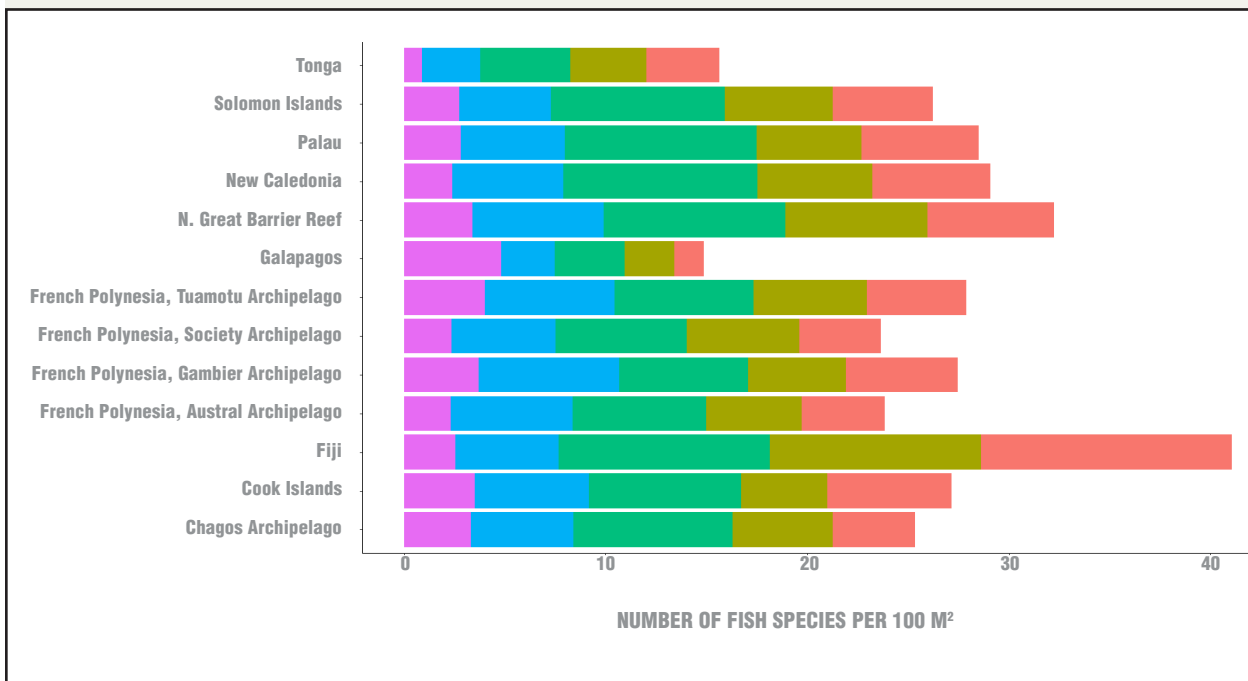
have the highest fish species richness, but this was not the case. Instead, the Lau Province, Fiji, had substantially higher species richness (41±7 species per 100 m²) than countries located geographically within or close to the boundary of the Coral Triangle. This high number of fish species indicates Lau Province, Fiji, is a unique area of the world that needs further consideration for conservation (Figure 21). N. GBR, which is geographically closer to the Coral Triangle, had the second-highest species richness (32±13 species per 100 m²), which was an average of nine fewer fish species seen per 100 m² than seen in Fiji.

Figure 21

FISH SPECIES RICHNESS (NUMBER FISH SPECIES PER 100 M²) IN PACIFIC AND INDIAN OCEAN LOCATIONS SURVEYED ON THE GRE. FISH SPECIES ARE GROUPED BY TROPHIC LEVEL (2.0-2.4, 2.5-2.9, 3.0-3.4, 3.5-3.9, AND 4.0-4.5) FOR EACH LOCATION SURVEYED IN THE PACIFIC AND INDIAN OCEANS. FIJI HAD THE MOST FISH SPECIES OBSERVED, BUT SIMILAR TO CORAL SPECIES RICHNESS, AS DISTANCE FROM THE CORAL TRIANGLE INCREASED, THE NUMBER OF FISH SPECIES OBSERVED DECREASED. THE MAJOR EXCEPTION WAS FOUND IN TONGA, WHERE FEW FISH RECORDED.

TROPHIC LEVEL

- 2.0-2.4
- 2.5-2.9
- 3.0-3.4
- 3.5-3.9
- 4.0-4.5



RESULTS

4.3

d

IDENTIFYING TRENDS ON THE REEFS OF THE PACIFIC AND INDIAN OCEANS

Due to the similar reef habitats and potential for connectivity of the reef organisms⁸⁴, data from the Pacific and Indian Oceans was combined for regression analysis to assess widespread trends on the reefs. Identifying the relationship between common algae types (CCA, turf, and macroalgae), live coral cover, and reef fish community composition is an important metric that can be used by managers to understand the status of a reef and develop specific goals for their management plans.

Regression analysis between the Pacific and Indian Oceans of percent coral cover against the individual algae groups yielded weak but significant correlations across all algal types, with the most significant correlations with CCA ($R=-0.32$, $p<2.2e^{-16}$) and turf ($R=-0.34$, $p<2.2e^{-16}$). As expected, as coral cover decreased, the percent cover of CCA and turf increased at almost the same rate, highlighting the dominance of these two algae groups.

To assess whether the fish populations have a correlation to the amount of coral or algal cover, regression analyses were run. This included running regression analyses

of total fish density, total fish biomass, and fish species richness against coral and the different algae groups. We did this to try to identify which fish and benthic metrics can be used to monitor the status of a reef. In all regression analyses between fish biomass, density, and fish species richness against coral and total algae, we found no significant correlation. This was true even when using trophic grouping of fish and individual algal groups such as CCA, turf, and macroalgae. The lack of relationship between the fish and benthic communities, even at a finer scale using trophic groupings, and highly variable results from analysis at the country level suggest external drivers are impacting the benthic and fish communities independently. The lowest trophic group (2.0-2.5) primarily consists of herbivores, and when regressed against the algae groups, including macroalgae, there was no significant relationship, suggesting the herbivorous fish are not directly controlling the benthic organisms. It is more likely that acute disturbances such as bleaching or fishing pressure are independently impacting the benthic and fish populations on these reefs.

Accute disturbances, such as **bleaching** and **fishing** are impacting **coral reefs**.

Overfishing was
evident at **nearly every**
location surveyed
on the **Global Reef**
Expedition.



GLOBAL REEF EXPEDITION

5.0

DISCUSSION



DISCUSSION

5.0

THE STATUS OF THE WORLD'S REEFS

A research expedition of this magnitude provides a plethora of data that can be used to better understand global trends on coral reefs. The GRE allowed us to map and collect vital data on the status of the world's reefs in some of the most remote locations that had never been studied before. The data collected on the GRE provides valuable insight into the world's reef dynamics, threats to coral reefs, and the ability of reefs to rebound from acute disturbances, which can help communities and managers battle the ongoing coral reef crisis.

5.1

CARIBBEAN REEFS AND IMPLICATIONS OF SHIFTING REEF DYNAMICS

Caribbean reefs had some of the lowest live coral cover, highest macroalgal cover, and lowest fish density and biomass of all the sites visited on the GRE (Figure 22). Our findings from the Caribbean show that despite widespread correlation between coral and macroalgae, regional or country-wide studies will be more useful in understanding shifting reef dynamics. A study by Precht et al. (2020) used coral and macroalgal survey data, collected between 1977 and 2001, from 197 sites throughout the Caribbean to better understand the possible phase shift from coral- to macroalgal-dominated reefs⁸⁵. They found that in some locations, macroalgae was more dominant than coral, while in others, such as Jamaica, the reef dominance shifted back to coral after a recovery period. The data collected on the GRE in Jamaica supports this hypothesis, as it showed no significant relationship between coral and macroalgae. Instead, the Jamaican reefs had a more even spread of algae groups than seen in other Caribbean countries. At the time of this study, it is possible Jamaican reefs were undergoing a phase shift from macroalgal-dominated reefs back to coral-dominated reefs, as suggested by Precht et al. (2020).

Many factors have contributed to the phase shift from coral to macroalgae in the Caribbean, and understanding the recovery mechanisms of these reefs will be an ongoing task for scientists and managers. One of the most interesting discoveries from the Precht et al. (2020)

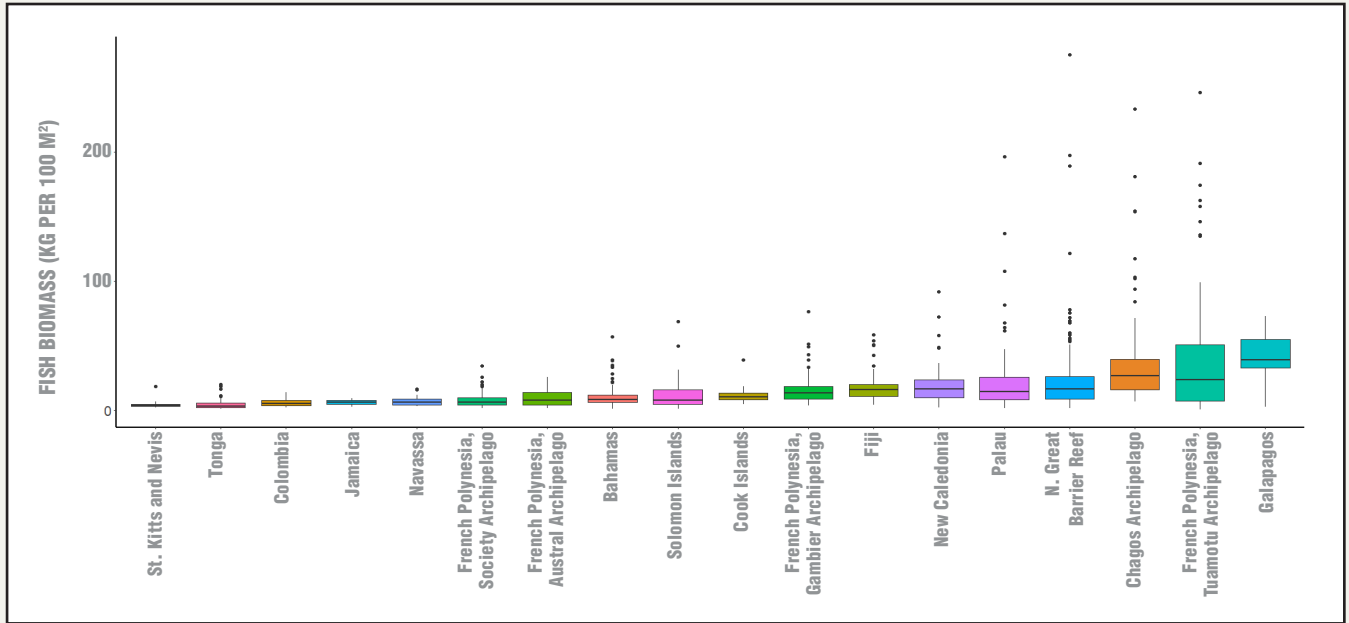
study was that herbivorous fish do not seem to have a significant effect on the abundance of live coral or macroalgae. Our data generally supported this hypothesis when looking at Caribbean-wide findings, as we saw a weak negative relationship between herbivorous fish density and biomass and macroalgal cover. However, when looking at country-wide trends, we instead found the relationship

was more variable. In areas where macroalgae was more prevalent, such as in The Bahamas and Navassa, there was a much stronger relationship between macroalgal cover and herbivorous fish biomass, suggesting that the relationship between herbivorous fish and benthic cover is more nuanced and that Caribbean-wide conclusions about this correlation cannot be made.

Caribbean reefs generally had low coral cover, few fish, and lots of algae.

Figure 23

BOXPLOTS IN ASCENDING ORDER OF MEAN FISH BIOMASS (KG PER 100M²) IN LOCATIONS SURVEYED IN THE CARIBBEAN, PACIFIC, AND INDIAN OCEAN. BOXPLOTS WERE CREATED USING MEAN FISH BIOMASS FROM SITE DATA IN EACH OF THE LOCATIONS SURVEYED. TONGA HAD VERY LOW FISH BIOMASS THAT WAS SIMILAR TO THE MEAN FISH BIOMASS SEEN IN THE CARIBBEAN. DOTS INDICATE OUTLIER SITE FISH BIOMASS DATA AND MEDIAN IS SHOWN BY THE CROSSBAR.



5.2

OVERFISHING: A GLOBAL PROBLEM?

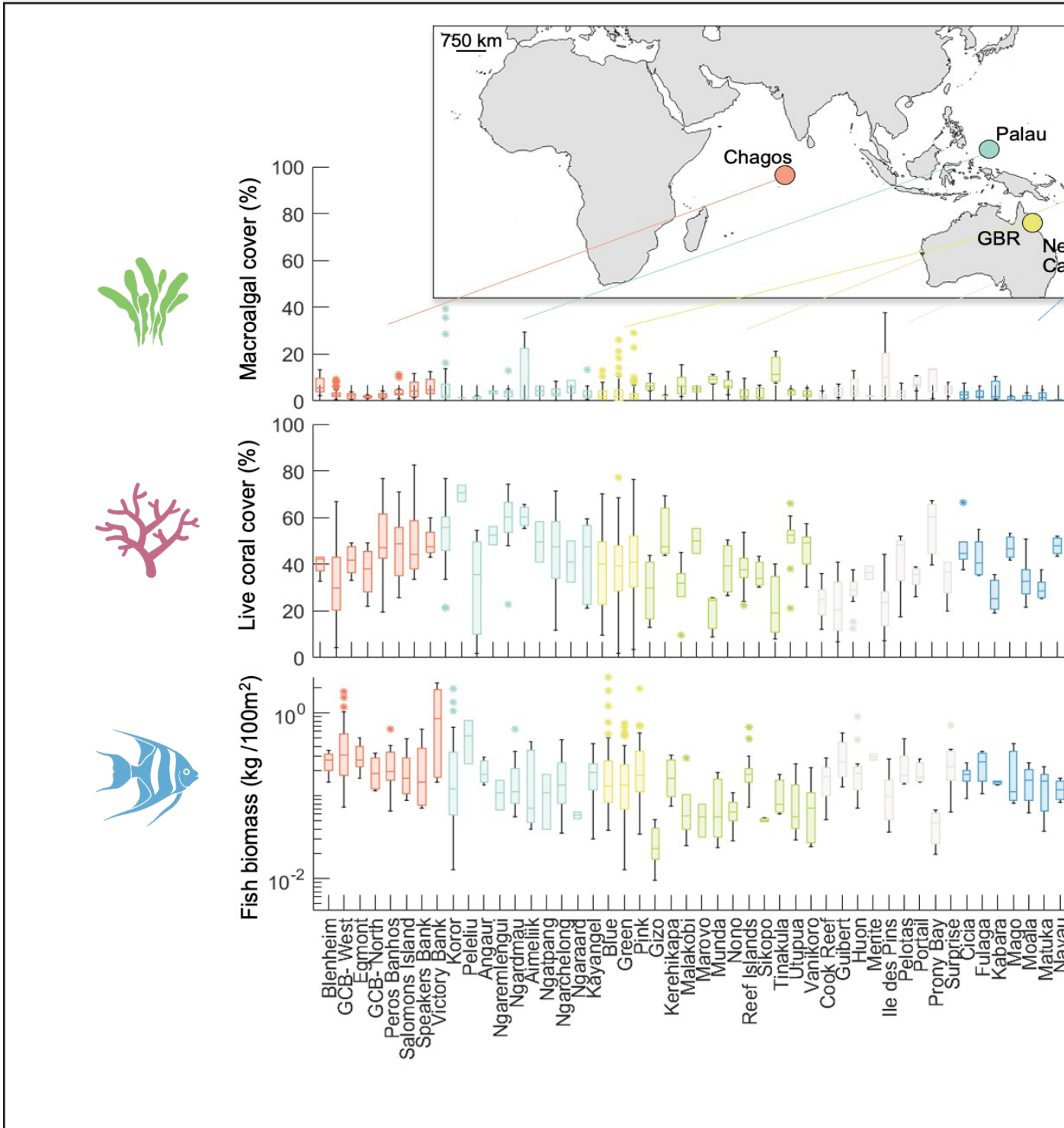
Reefs in the Pacific and Indian Oceans generally had higher fish biomass and density than what was seen in the Caribbean (Figure 23). Some studies estimate that reef fish biomass should be between 11 and 19 kg per 100m², and most countries had mean fish biomass at or below this threshold^{26,82,83}. The data used to establish these thresholds was expansive and was collected in both the western Indian Ocean (McClanahan et al. 2015) and the Caribbean (Karr et al. 2015). The data collected in these studies overlapped many locations surveyed on the GRE. The Caribbean study by Karr et al. (2015) confirmed that the baseline threshold suggested by McClanahan et al. (2015) can be applied to Caribbean reefs and found that the mean fish biomass of unfished reefs in the Caribbean was higher than the mean biomass measured in the Indian Ocean. It is worth noting that due to well-documented degradation of the Caribbean reefs, Karr et al. (2015) also suggests that

a ratio between fish biomass on fished and unfished reefs measured locally may provide a more accurate metric for managers to use when determining a baseline threshold for their country. Using the thresholds suggested by these studies, we found Colombia, Jamaica, Navassa, St. Kitts and Nevis, Tonga, and the Society and Austral Archipelagoes of French Polynesia all had mean fish biomass below this threshold; The Bahamas, the Cook Islands, the Gambier Archipelago of French Polynesia, and the Solomon Islands fell within the range. At the time of our surveys, many of these countries that had low fish biomass lacked substantial reef fisheries management and will need aggressive regulations and enforcement to prevent these reef fish populations from declining further. New Caledonia and Palau each had fish biomass of 19.1 kg per 100 m² and should continue to monitor and manage their reef fisheries to stay above this suggested baseline threshold.

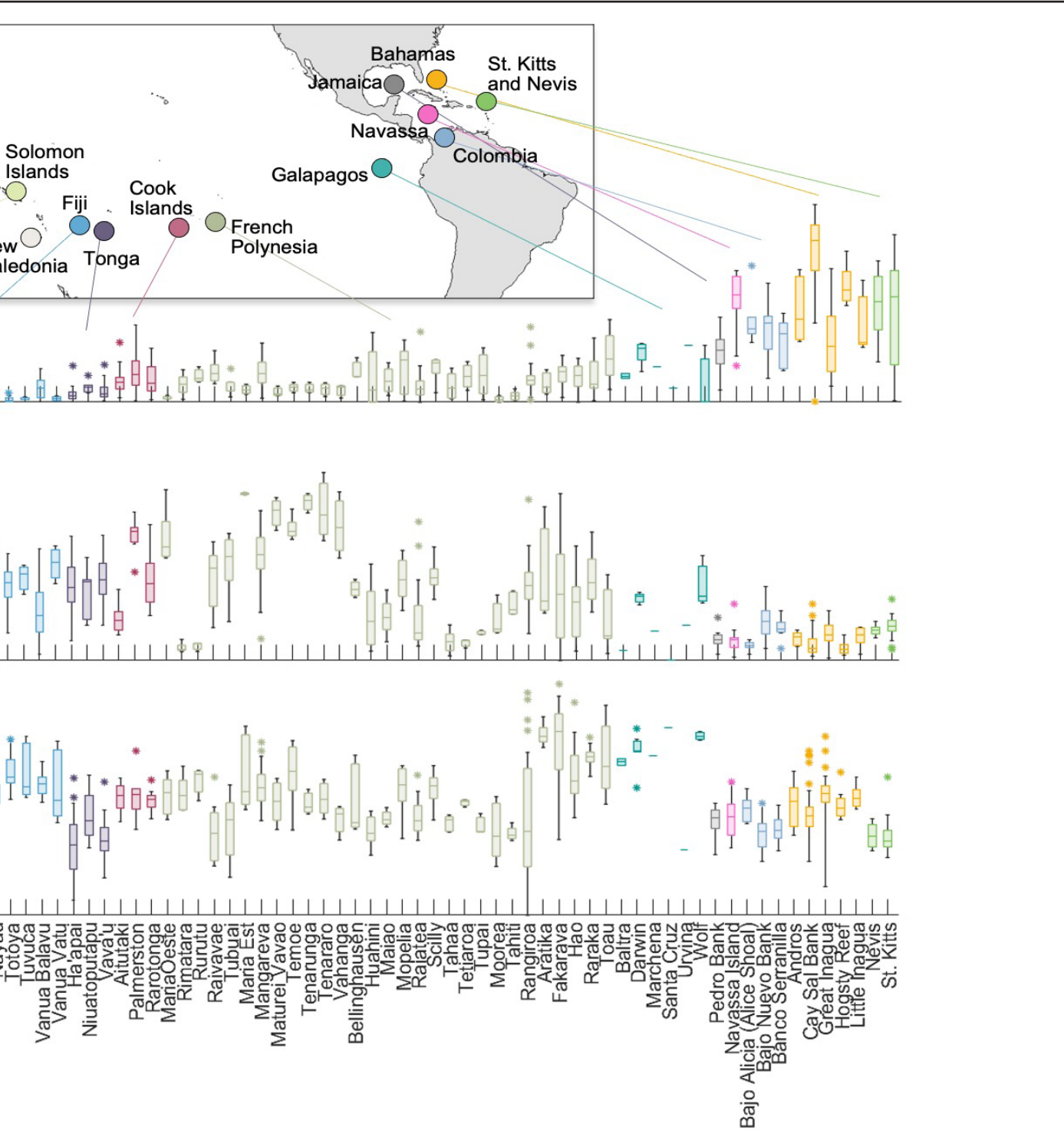
DISCUSSION

Figure 22

BOXPLOTS OF LIVE MACROALGAE COVER (%), LIVE CORAL COVER (%), AND MEAN FISH BIOMASS (KG PER 100 M²) OF ALL ISLANDS SURVEYED



ON THE GLOBAL REEF EXPEDITION. ISLANDS ARE GROUPED BY COUNTRY BASED ON COLOR INDICATED IN THE MAP.



DISCUSSION

One of the most interesting findings was the high fish species richness and moderate fish biomass of the Lau Province, Fiji. The Lau Province is a group of remote, sparsely populated islands and atolls found in the southeast region of Fiji. The fish communities there had high diversity, but most of the fish were small, with few large fish remaining (Figure 24). Most of the fish density, biomass, and species richness were made up of fish from lower trophic levels that are typically small and not important for local fishers (Figures 20a and b).

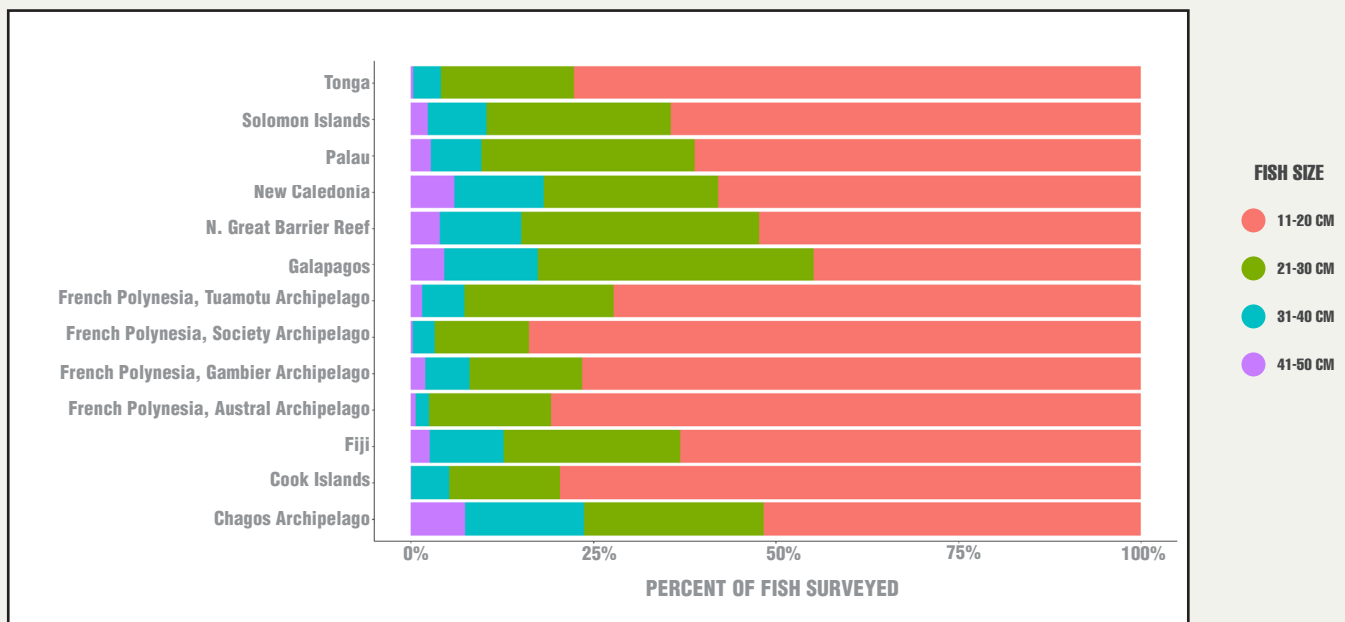
Across all countries surveyed in the Pacific Ocean, most of the ecologically and economically important species (Family: Acanthuridae, Carangidae, Haemulidae, Lethrinidae, Lutjanidae, Nemipteridae, Scaridae, Serranidae, and Siganidae) were less than 20 cm in length (Figure 24). This indicates that the larger reef fish of these families are being overexploited, and this could

have long-term repercussions on reef fish populations in the future. The Chagos Archipelago had the highest level of protection and is a no-take, no-entry MPA. The reef fish of Chagos had a more even size distribution in these same families. (Figure 24).

Coral reefs in Lau Province, Fiji had surprisingly high fish species richness.

Figure 24

THE RELATIVE SIZE DISTRIBUTION (%) OF SELECTED IMPORTANT FISH FAMILIES IN LOCATIONS SURVEYED IN THE PACIFIC AND INDIAN OCEANS. FAMILIES INCLUDED WERE: ACANTHURIDAE, CARANGIDAE, HAEMULIDAE, LETHRINIDAE, LUTJANIDAE, NEMIPTERIDAE, SCARIDAE, SERRANIDAE, AND SIGANIDAE. FISH WITH TOTAL LENGTHS BELOW 10 CM AND GREATER THAN 50 CM WERE EXCLUDED. IN ALL LOCATIONS, FISH LESS THAN 20 CM ACCOUNTED FOR THE HIGHEST PROPORTION OF FISH SURVEYED IN THESE FAMILIES. THIS INDICATES THAT IN MOST LOCATIONS, COMMERCIALY IMPORTANT REEF FISH POPULATIONS ARE MADE UP OF SMALL FISH.



5.3 IMPACT OF ACUTE DISTURBANCES ON REEFS IN THE PACIFIC AND INDIAN OCEANS

Large-scale coral cover trends were hard to identify because, for the past century, corals have been impacted greatly by both natural and anthropogenic disturbances. In numerous locations in the Pacific Ocean, we found that acute disturbances, such as COTS outbreaks and cyclone and tsunami damage, had greatly reduced the live coral cover on reefs^{56,57,61}. However, we did not find a significant correlation between lower coral cover and fish biomass or a shift in the algal composition. It is possible that not enough time had passed between the disturbance and our surveys to see a measurable change in the correlation of these metrics.

The areas with the lowest coral cover in the Pacific Ocean had, at the time of surveying, very recently been ravished by a COTS outbreak. This was particularly evident in the Society and Austral

Archipelagoes of French Polynesia and the Cook Islands. For example, at Aitutaki, an atoll surveyed in the Cook Islands, KSLOF scientists witnessed an active outbreak of COTS, and we removed over 600 COTS from the reef (Figure 25). The coral cover at one site had been reduced to 10%⁵⁶. In French Polynesia, it appeared an outbreak of COTS first hit the Society Archipelago and then the Austral Archipelago. While surveying the reefs in the Society Archipelago, we found that entire reef systems had been ravaged by these corallivores, but we also found encouraging evidence of recovery. We saw many small coral recruits, and a recent study by Pérez-Rosales et al. (2021) found that the Society Archipelago was able to more successfully recover from COTS outbreaks than other French Polynesian archipelagoes⁵⁶.

Figure 25

SCIENTISTS ON THE GLOBAL REEF EXPEDITION REMOVED HUNDREDS OF CROWN-OF-THORNS STARFISH FROM THE CORAL REEFS OF AITUTAKI IN THE COOK ISLANDS.



5.4

A SIGN OF HOPE FOR THE WORLD'S REEFS

The coral reef crisis was evident everywhere the Global Reef Expedition surveyed. Reefs in the Caribbean had low coral cover and few fish, and overfishing was evident in nearly every country we visited. However, there were still signs of hope. Large marine protected areas and adaptive management plans have been shown to be successful in conserving coral reefs, and may be the best tool we have to combat the coral reef crisis.

In the Pacific and Indian Oceans, the reefs with the highest coral cover, fish biomass, and fish density were found in either remote locations or areas with high protection and management. The Gambier Archipelago of French Polynesia had the highest mean live coral cover ($52 \pm 14\%$), and the Tuamotu Archipelago had the highest mean fish density (278 ± 165 fish per 100 m^2) and second-highest mean fish biomass (40 ± 48 kg per 100 m^2) seen on the GRE. These archipelagoes had the lowest direct impact from humans in French Polynesia⁵⁷ and, at the time of the surveys, had not experienced a significant natural disturbance in recent years.

However, remote areas were not the only locations with high coral cover and a stable reef fish community. Palau, while having a substantial human population that directly relies on the reefs, had the second-highest coral cover in the Pacific and fish biomass above the baseline threshold, indicating a stable reef fishery. Since the 1950s, Palauans have prioritized conserving their coral reefs by establishing management plans protecting their reefs from direct human impacts, particularly focusing on subsistence fishing, managing runoff, and recreational use. These management efforts have likely helped relieve pressure on the reef organisms so they can better withstand natural disturbances. Palau is one of the few places that were able to endure the recent global bleaching events with minimal impacts⁸⁷. The lack of additional pressure from humans has likely helped Palau's coral reefs recover and be more resilient to these otherwise catastrophic events.

The GRE visited many sites that had well-established reef management plans and parks. The Chagos Archipelago is one of largest and oldest no-take, no-entry marine parks in the world and boasted some of the highest coral cover and fish biomass seen on the GRE. However, it is not realistic for most reefs to have this level of protection.

The Northern Great Barrier Reef in Australia is an example of a large managed area that has regions zoned as no-take, no-entry, or fished. We found the reefs of the N.GBR to be some of the best seen on the GRE, as they had some of the lowest algal cover and highest coral richness, and the second-highest mean fish species richness seen on the GRE (Figure 21). Using data collected on the Global Reef Expedition, our partners at the University of Queensland, Australia, used data from sites surveyed in the farthest north region of the Great Barrier Reef Marine Park to assess whether marine reserves were benefiting the benthic and reef fish communities. Castro-Sanguino et al. (2017) found that the marine reserves enhanced the biomass of highly targeted piscivores and other less targeted carnivores. They suggest that protection from fishing benefits fish populations in even lightly fished areas on the GBR⁸⁸. These findings highlight the benefits of large marine parks and the need for adaptive management practices to be implemented and enforced across the globe in order to help conserve the world's reefs.

Large marine parks and
adaptive management
practices are needed to
conserve coral reefs.



6.0

**EDUCATION &
OUTREACH**



EDUCATION & OUTREACH

6.0

EDUCATION & OUTREACH ON THE GRE

Education and outreach were critical components of the Global Reef Expedition. The foundation launched several in-country programs, which were designed to share the foundation's knowledge about coral reefs with community members, local and traditional leaders, teachers, and schoolchildren, but also to learn from communities who depended heavily upon coral reefs for their lives and livelihoods. In addition, the foundation created education and outreach programs to share the beauty and wonder of coral reefs with people around the world, improve ocean literacy, and educate and inspire the next generation of ocean advocates.

Initially, the foundation conducted educational seminars for hundreds of elementary and high school students in the Washington, D.C., area. Presentations covered a range of topics about coral reefs and the Global Reef Expedition. After successful implementation of local school seminars, the foundation expanded its educational programs to stakeholders in GRE countries. The

education team provided coral reef seminars to a variety of different audiences including schools, communities, government officials, and tourists. Tours of the *M/Y Golden Shadow* were provided in some countries, which provided students, community members, and government officials with detailed information about the research being conducted. Cultural liaisons and scientific advisors

from the partner country were invited on GRE missions to consult with communities and assist with education programs and ship tours. The foundation also hosted numerous community events to share our research, learn how communities were using their coastal marine resources, and showcase the wonders of the ocean through films. In total, over 7,000 people attended coral reef seminars, community events, and ship tours in Jamaica, French Polynesia, Tonga, Fiji, and the Solomon Islands

(Figure 26).

Figure 26 THE GLOBAL REEF EXPEDITION EDUCATED THOUSANDS OF LOCAL STUDENTS ABOUT THE IMPORTANCE OF THEIR CORAL REEFS, INCLUDING THESE STUDENTS FROM TUVUCA, FIJI.



The government and community seminars proved to be especially important. Not only was the foundation providing education about coral reefs, but we also received valuable local environmental information from the participants. Government officials and community members shared knowledge about the usage of reef resources and the issues that they observed, and discussed possible solutions and alternatives to these problems. The foundation learned about deadly crown-of-thorns starfish outbreaks, destructive fishing practices, targeted species being harvested, and species no longer seen on their reefs. Concerned community members also expressed that they wanted to protect their reefs by implementing marine managed areas and sustainable fishing practices. Most also commented on a need for further school and community education programs.

The foundation provided teachers with an opportunity to join scientists on some expeditions through the Coral Reef Educator on the Water (CREW) program. While on the mission, CREW teachers conducted education workshops and presentations for local students and community members, developed educational materials, and broadcast lessons to students online. When they completed the expedition, CREW teachers continued to improve ocean literacy by sharing the knowledge and experience they gained on the GRE with students in their classes and schools.

One common theme that was recognized on the GRE was the lack of knowledge about coral reefs and adjoining ecosystems such as mangrove forests and seagrass beds. As a result, the foundation decided to help mitigate the environmental degradation of marine ecosystems through education. Three education programs were developed to help address this need: the Mangrove Education and Restoration Program, the Coral Reef Ecology Curriculum, and the Science Without Borders® Challenge.

In addition to the educational programs for students, community members, and government officials, the foundation provided fellowships for Ph.D. students and postdoctoral scholars. In total, the foundation supported nine Global Reef Expedition Fellows, who joined a portion of the expedition to conduct their own coral reef research and support the scientific research goals of the GRE.

The foundation also sought to educate people about the marine environment by sharing the beauty and wonder of the places we visited on the Global Reef Expedition through films and photographs. Award-winning cinematographers and photographers joined many of the GRE missions, showcasing remarkable coral reefs, educating people about threats to coastal marine ecosystems, and illustrating important marine conservation success stories. The films and photographs created on the Global Reef Expedition have been shown around the world, transporting people to places they may never have a chance to visit themselves and giving them a glimpse into the remarkable underwater world that may otherwise be out of sight and out of mind.

Education and outreach were critical components of the Global Reef Expedition.

EDUCATION & OUTREACH

6.1

COMMUNITY EDUCATION AND OUTREACH

The Global Reef Expedition revealed a need for ocean education around the world. The foundation responded by developing various education curricula and programs for different audiences. These programs leveraged the films and photographs that were produced during the GRE to bring the underwater world to audiences and inspire people to preserve the ocean. Each year, these programs continue to grow and expand, teaching thousands of youth, educators, and communities from all around the world about the importance of the ocean and how to protect it.

6.1

a

WASHINGTON, D.C.

Close to 250 elementary and high school students attended educational presentations in the Washington, D.C., area. The seminars covered a variety of coral reef themes, including basic information about corals, threats and benefits of reefs, and food webs. Many seminars also brought the GRE to life for many students. Some classrooms were able to connect with scientists on board the ship who taught students about ship life and how to conduct scientific research on coral reefs. These interactions with scientists allowed students to ask probing questions about coral reefs and what it is like to be a scientist.

6.1

b

JAMAICA

For the first time, land-based education programs were implemented during the GRE in Jamaica. While the *M/Y Golden Shadow* was in Port Antonio, education programs were conducted. A Conservation Planning Workshop was held for Port Antonio High School and the College of Agriculture, Science, and Education (CASE) students to understand more about the importance of coral reefs and what can be done to protect them. After the workshop, students toured the ship to get a firsthand glimpse at how coral research is conducted.

A workshop was also held for local fishers in the area. The workshop included initial results from the GRE about the current status of fish populations on Pedro Bank. To showcase the foundation's new education efforts while on the GRE, a film called [*Getting People Interested in Vital Research*](#) was produced.

6.1

c

TUAMOTU ARCHIPELAGO, FRENCH POLYNESIA

As the foundation continued to circumnavigate the globe, education continued on the GRE. When the ship docked in the Tuamotu Archipelago in French Polynesia, it allowed 50 students from Fakarava Primary School to board the *M/Y Golden Shadow* to learn about corals and the research that was being conducted from the ship. At the end of the tour, students were able to ask mission scientists questions about coral reefs.

Figure 27

STUDENTS AT THE PRIMARY SCHOOL IN TOTOYA, FIJI PARTICIPATE IN AN ACTIVITY THAT TEACHES THEM ABOUT THE CORAL REEF FOOD WEB.



6.1

d

LAU PROVINCE, FIJI

During the Fiji GRE mission, land-based coral reef education seminars were provided throughout the Lau Province to primary and secondary schools as well as village communities. Overall, the foundation conducted 14 school and eight village seminars. Additional seminars were provided in Fiji's capital, Suva, for faculty and students at the University of the South Pacific, government officials at the Ministry of Fisheries, and various coral reef stakeholders at the International Union for Conservation of Nature (IUCN). In total, these educational programs reached almost 1,500 people on 10 different islands in the Lau Province.

This was the first time in the foundation's history that a single GRE mission was dedicated to providing extensive land-based education programs in conjunction with scientific research (Figure 27). This pilot program later provided critical insight for future GRE education programs in Tonga and the Solomon Islands. A short film called [A Fabulous Encounter in Fiji: Coral Reef Outreach and Education](#) was produced to demonstrate the success of the foundation's Fiji education program.

These educational efforts were conducted in partnership with local Fijian representatives. In Fiji, each village is responsible for protecting its marine resources, especially in protected areas called Locally Managed Marine Areas (LMMAs). Dedicated to the foundation's education mission, the liaisons helped to establish community and school relationships and provide the seminars in Fijian. The Fijian liaison roles were critical not only to the success of the education programs but also for granting permission for foundation scientists to conduct research near local villages.

EDUCATION & OUTREACH

6.1 e

KINGDOM OF TONGA

After completing an effective pilot coral reef education program in Fiji, the foundation decided to implement the program in the Kingdom of Tonga. The programs were provided on 19 different islands in three different island groups: Ha'apai, Vava'u, and Niuatoputapu (Figure 28). Once again, a variety of different targeted stakeholders were invited to attend the coral reef seminars. Overall, the foundation conducted 15 school, 17 community, one tourist, and one government meeting, and three ship seminars, reaching just over 2,300 people. These educational efforts were conducted in partnership with local Tongan representatives from the Government of Tonga and a local nongovernmental organization (NGO) called Vava'u Environmental Protection Association (VEPA). Like the Fijian representatives, the Tongan liaisons were crucial to the success of the entire mission.

The land-based education efforts in Tonga paved the way for future school-based education programs in Vava'u. The willingness of the Tongans and overwhelming outpouring for coral reef education from local schools made Tonga an ideal partner to pilot additional programming over the next two years. The foundation produced a film about these educational efforts called [Reefs on the Road](#).

Figure 28

THE GOVERNMENT PRIMARY SCHOOL (GPS) TU'ANEKIVALE IN VAVA'U ISLAND GROUP IN TONGA WELCOMES THE KHALED BIN SULTAN LIVING OCEAN'S EDUCATION TEAM TO THEIR SCHOOL. KSLOF CONTINUED WORKING WITH LOCAL SCHOOLS ON CORAL REEF EDUCATION PROGRAMS LONG AFTER THE MISSION TO TONGA WAS COMPLETED.



6.1



SOLOMON ISLANDS

While on the Solomon Islands mission, the education team once again provided land-based education seminars throughout the Western, Choiseul, Isabel, and Temotu Provinces at schools and communities. During the mission, schools were either taking exams or on holiday break, so most of the seminars were provided to communities, where men, women, and children attended the talks. Overall, the foundation conducted four school and 25 community seminars and four ship tours, reaching a total of 2,891 people. This was the greatest number of people reached on a single GRE mission.

Just as in Fiji and Tonga, the seminars focused on teaching islanders about corals, the threats to coral reefs, how people benefit from this ecosystem, and what they can do to protect their coral reefs (Figure 29). Each seminar ended with a community discussion. Often, it was the community chiefs and elders who would address the community and voice their concerns about protecting the coral reef.

Figure 29

EDUCATION AND OUTREACH SEMINARS IN THE SOLOMON ISLANDS FOCUSED ON TEACHING ISLANDERS ABOUT CORAL REEFS, THE THREATS THEY FACE, AND HOW PEOPLE BENEFIT FROM THIS COASTAL MARINE ECOSYSTEM.



EDUCATION & OUTREACH

6.2

CORAL REEF EDUCATOR ON THE WATER PROGRAM

The Coral Reef Educator on the Water (CREW) program offered high school science teachers the opportunity to join the GRE on missions aboard our research ship (Figure 30). The program was designed to give teachers firsthand experience of life on board a working scientific research vessel, a greater understanding of the importance of coral reefs, and the inspiration to convey what they learned to their students and members of their community.

As part of the GRE, each CREW participant worked with the science team to develop educational content and lesson plans, hosted a live Q&A session for students from on board the ship, and developed a conservation action challenge for their classroom. They also participated in educational outreach efforts to share our knowledge of coral reefs with local students, teachers, and community members where we conducted research.

Figure 30

THE CORAL REEF EDUCATOR ON THE WATER (CREW) PROGRAM OFFERED HIGH SCHOOL SCIENCE TEACHERS THE OPPORTUNITY TO JOIN THE GLOBAL REEF EXPEDITION.



6.3

INTERNATIONAL EDUCATION PROGRAMS

While educating both students and adults around the world, one thing became apparent – there was a lack of knowledge and resources to teach people about the ocean. As a result, education programs and materials were developed to aid people in learning about ocean ecosystems, especially coral reefs and mangroves. Three education programs evolved from the GRE: the Mangrove Education and Restoration Program, the Coral Reef Ecology Curriculum, and the Science Without Borders® Challenge.

6.3

a

MANGROVE EDUCATION & RESTORATION PROGRAM

One successful education initiative, developed to educate teachers and youth about mangrove ecosystems, is called the [Mangrove Education and Restoration Program](#). Many local partnerships with governments and nonprofit environmental organizations were shaped during the GRE. As a result, the foundation partnered with these organizations to implement the Mangrove Education and Restoration Program in The Bahamas and Jamaica. This extensive two-year mangrove program provides students with an in-depth learning experience. For two years, students learn about the basic ecology of mangroves using a combination

of lectures, reinforcement activities, field experience, and two long-term scientific investigations (eight months each). During the first year, students conduct a mangrove growth experiment. They grow and monitor their mangroves, and plant them at the end of their experiment. In the second year of the program, students set up quadrats to monitor the forest and investigate mangrove disease. Students collect and analyze data during their investigations and then draw conclusions from it. Over time, students and teachers can see the positive change they make to the forest and their coastal community.

6.3

b

CORAL REEF ECOLOGY CURRICULUM

To address the lack of coral reef education around the world, the foundation developed a robust, award-winning Coral Reef Ecology Curriculum. The curriculum is hosted on the foundation's [Education Portal](#), making it easily accessible to anyone around the world who wants to learn about coral reefs. The curriculum was developed for use in K-12 classrooms, and it has been particularly beneficial to [e-learning](#) since the beginning of the COVID-19 pandemic, which has required students to learn

online. There are 12 units currently available, and they include a variety of educational resources such as videos, interactives, activities, and quizzes. Almost 300,000 people have accessed the Education Portal from 167 countries and all 50 US states. Additionally, the foundation offers two-day teacher professional development workshops to educate teachers about coral reefs and the use of the Education Portal materials in their classrooms.

6.3

C

SCIENCE WITHOUT BORDERS® CHALLENGE

Despite creating robust mangrove and coral reef curricula, the foundation observed that some youth were not as engaged in learning about science. The foundation was eager to create a program that would inspire young students to learn about the ocean through a different learning path – art. Therefore, the foundation developed an annual international art contest called the [Science Without Borders® Challenge](#) to inspire youth all around the world to learn about various ocean conservation issues by creating artwork. Each year, a new ocean conservation theme is revealed.

The contest is open to all students 11-19 years old who are enrolled in primary school, secondary school, or the homeschool equivalent. The artwork is judged in two categories: 11- to 14-year-olds and 15- to 19-year-olds. Winners in each category receive a prize of up to \$500. Since 2013, almost 3,000 students from 90 countries have participated in the contest ([Figure 31](#)). The foundation uses the students' artwork to raise awareness and spark conversations about ocean conservation.

Figure 31

THOUSANDS OF STUDENTS HAVE PARTICIPATED IN THE FOUNDATION'S ANNUAL OCEAN ART CONTEST, THE SCIENCE WITHOUT BORDERS® CHALLENGE, INCLUDING ONE OF THE 2021 WINNERS, "STOP, LET'S PRESERVE OUR MANGROVES" BY 16-YEAR-OLD MICHELLE YANG.



6.4 FELLOWS

The foundation sponsored a fellowship program for doctoral students and postdoctoral scholars whose research focused on activities that contribute to a better understanding of the health and resilience of coral reefs in countries surveyed throughout the Global Reef Expedition. This fellowship program welcomed scientists from around the world, regardless of citizenship or nationality, with a career interest in coral reef science or management. In addition to graduate students and postdocs working at a university, the program welcomed recent graduates employed

by a government agency and conducting research on coral reef conservation and management. Fellows received generous support from the foundation, including an award to cover legitimate educational and research expenses, such as tuition and research fieldwork. All costs (lodging, meals, diving activities, etc.) while on board our research ships, as well as travel to the research location, was covered by the foundation so these early-career scientists could participate in this once-in-a-lifetime research expedition.

THE KHALED BIN SULTAN LIVING OCEANS FOUNDATION HONORED NINE SCHOLARS WITH RESEARCH FELLOWSHIPS TO JOIN THE GLOBAL REEF EXPEDITION:

- **Dr. Sarah Hamylton**, a postdoctoral scholar working on marine resource management at Southampton University, joined us on our research missions to the Red Sea.
- **Gwilym Rowlands**, a student working under Dr. Sam Purkis at Nova Southeastern University. His KSLOF Fellowship project “A spatial perspective on coral reef development in the Saudi Arabian Red Sea” allowed him to participate in the Global Reef Expedition research in the Red Sea.
- **Renata Farreri**, a doctoral student at the University of Exeter working with Dr. Pete Mumby. She used her KSLOF Fellowship to join us on the Global Reef Expedition to study the effects of coral-algae competition on the growth rate and mortality of coral colonies.
- **Jeremy Kerr**, a doctoral student working under Dr. Sam Purkis at Nova Southeastern University. His KSLOF Fellowship allowed him to participate in Global Reef Expedition missions in the Caribbean and the Pacific and Indian Oceans, mapping coral reefs using a combination of satellite imagery and field observations.
- **Sonia Bejarano**, a postdoctoral scholar from Colombia, joined the GRE missions in the Caribbean and in French Polynesia to study fish grazing as a source of reef resilience.
- **João Monteiro**, a Ph.D. student at the University of the Azores who joined the Global Reef Expedition on many of our research missions in the Pacific Ocean to study *Symbiodinium spp.* diversity.
- **Badi R. Samaniego**, a doctoral student at the University of the Philippines working on coral reef fish ecology. His KSLOF Fellowship allowed him to participate in most of the GRE missions to the Pacific and Indian Oceans and study reef fish communities.
- **Dr. Anderson Mayfield**, a postdoctoral scholar working on coral genetics at the National Museum of Marine Biology and Aquarium in Taiwan. His KSLOF Fellowship allowed him to sample corals from various sites visited on the Global Reef Expedition to assess their resiliency.
- **Dr. Steve Saul**, a postdoctoral scholar working at the National Marine Fisheries Service. For his KSLOF Fellowship, he developed models that look at how coral-reef-dependent fisheries can most appropriately be managed to meet subsistence needs while protecting biodiversity in small island developing states.

EDUCATION & OUTREACH

6.5

MEDIA

At the Khaled bin Sultan Living Oceans Foundation, we know that studying and understanding our oceans is critically important, but to save our oceans, we need to inspire people to protect them. The foundation brings joy and a deeper understanding of the ocean to people around the world through engaging films and photography. These types of media have the potential to transport people to places they may never otherwise see, make complicated science easy to understand, and connect people viscerally and emotionally to the incredible beauty of the natural world.

6.5

a

FILMS

Since the start of the Global Reef Expedition, the foundation has produced over 100 [films](#). These films shared the beauty and wonder of coral reefs with people around the world, showcased the foundation's work in the field, and provided engaging educational material for our Coral Reef Ecology Curriculum. They have been recognized for their outstanding production and conservation value as well as their conservation message by earning 42 awards. Many of the foundation's community outreach programs showcased films produced on the Global Reef Expedition, sharing the beauty and wonder of the underwater world. The award-winning films have been showcased at film festivals around the world, broadcast on television, streamed online, and incorporated into the foundation's educational materials.

All the foundation's full-length films have won awards and international acclaim. One film, [Sharks of the Coral Canyon](#), won the 2015 Suncoast Emmy® Award for Best Environment Program. This film was shot on the Global Reef Expedition in French Polynesia. It tells the story of how sharks and coral reefs are intricately linked and uncovers how they depend on one another and must be protected together if either of them is to survive into the future.

6.5

b

PHOTOGRAPHY

The foundation invited professional underwater [photographers](#) on several Global Reef Expedition missions to capture the beauty of coral reefs and the threats they face. Some of the best images from the GRE come from the foundation's partnership with the [International League of Conservation Photographers \(iLCP\)](#), a nonprofit organization that enlists some of the world's best conservation photographers to advance conservation communication efforts around the world.

Three iLCP photographers took part in the expedition. Michele Westmorland joined the GRE to capture the vibrant reefs of French Polynesia, Jürgen Freund documented the scientific research conducted on the Northern Great Barrier Reef, and Keith Ellenbogen shot amazing photos of the diversity and abundance of life on reefs in Palau. Not only do these beautiful images document the foundation's journey, but they also show people, viscerally and emotionally, the wonders of coral reefs and illustrate why they should be protected.

Studying our oceans is
critically **important**, but
to **save our oceans** we
need to **inspire** people to
protect them.



GLOBAL REEF EXPEDITION

7.0

CONSERVATION



CONSERVATION

7.0

THE FUTURE OF THE WORLD'S REEFS

In every location we surveyed on the GRE, evidence of the coral reef crisis was apparent, regardless of remoteness or protected status. Given that the GRE began nearly 10 years ago, it is important to note that the coral reef crisis has only worsened, and we expect many of the reef conditions to have declined. Drastic measures are needed to help conserve the world's reefs. The following are five conservation takeaways the GRE.

1. SWIFT ACTION IS NEEDED TO ADDRESS CLIMATE CHANGE.

Currently, the biggest threat to coral reefs is climate change. Climate change is not only affecting ocean temperatures, but also is acidifying the world's oceans, increasing storm frequency and severity in the tropics, and more frequent and prolonged warming events are causing massive die-offs of corals at an astounding rate^{16,92,93}.

On the very last survey location of the GRE, in the Chagos Archipelago, our team of scientists first documented what would become a historic bleaching event that spread

across the globe. In Chagos, we saw some of the most pristine reefs of the world, with live coral cover reaching 82% at some sites. After this bleaching event, when the area was resurveyed, Sheppard et al. (2017) found the coral cover had been reduced to 5-15% two years later⁹⁴. Chagos is one of the most highly protected areas in the world, and has been largely undisturbed for the last 50 years. The fact that this remote reef system experienced unprecedented bleaching is alarming and highlights the magnitude of the impact the coral reef and climate crises are having on the world.

Ocean acidification (OA) is also having widespread impacts on the world's reefs, regardless of remoteness

or protection level. Ocean acidification is a direct result of climate change and is caused by the uptake of atmospheric CO₂ by the world's oceans. This increase in CO₂ in seawater causes an overall decrease in pH, making the oceans more acidic. This decrease in pH has been shown to depress calcification of reef organisms, particularly coral, which can lead to weaker skeletons

and make them more vulnerable to biologically-mediated chemical dissolution, as well as impacting non-calcifying organisms such as reef fish^{87,95,96}.

Our partners from the US National Oceanic and Atmospheric Administration (NOAA) joined the GRE to measure pH at locations surveyed throughout the Pacific Ocean. Manzello et al. (2021) found that areas of high coral cover are actually boosting OA by making the water more acidic through respiration. They also suggest that the duration and magnitude of exposure to lower pH may be greatest on reefs with the highest coral cover⁹³. These findings imply that even reefs with the best conditions may face a more substantial impact from climate change, particularly ocean acidification, if nothing is done to address this global problem.

The biggest threat to coral reefs is climate change.

2. REEF FISH POPULATIONS ARE BEING OVEREXPLOITED GLOBALLY.

One of the most worrisome findings on the GRE was that nearly every country surveyed showed signs of overfishing (Figure 32). All countries in the Caribbean and four locations in the Pacific had total fish biomass at or below the estimated threshold for a sustainable reef fish community. Including size class assessments of families fished for subsistence and commercial fisheries, nearly every country had predominantly small fish remaining, indicating the world's reef fish populations are at risk of being overexploited.

Around the world, nearly 500 million people rely on coral reefs for sustenance, subsistence, coastal protection, and tourism-based income¹⁰⁰. Most reef fish populations are unable to withstand the fishing pressure they are currently experiencing. It is

important to recognize that reef fish play a larger role than just providing sustenance to humans. They are a critical component in a stable reef system. A study completed on the Great Barrier Reef immediately following a large-scale bleaching event showed that large herbivorous fish played a vital role in managing macroalgae growth following the disturbance. The study showed that in areas where large herbivores were protected and abundant, coral cover nearly doubled when compared to the fished, unprotected reefs⁸⁸.

We commend the many communities and managers throughout the world working on enforcing management plans to address local overfishing. We hope our maps and findings from this report can be used in their management efforts.

Figure 32

NEARLY EVERY COUNTRY SURVEYED ON THE GLOBAL REEF EXPEDITION SHOWED SIGNS OF OVERFISHING. SMALL FISH WERE ABUNDANT ON MANY REEFS, SUCH AS THIS REEF IN THE SOLOMON ISLANDS, BUT FEW LARGE FISH REMAINED. THIS INDICATES CORAL REEF FISH ARE AT RISK OF BEING OVEREXPLOITED.



CONSERVATION

3. IDENTIFYING AND ADDRESSING ACUTE REEF DISTURBANCES CAN AID IN REEF RECOVERY.

The world's reefs are being dismantled from all sides and without substantial conservation and mitigation efforts, it is probable that they may never recover. Natural and human-caused acute disturbances, such as COTS outbreaks, storm damage, high nutrient runoff, and overfishing have caused extensive damage to reefs around the world⁹⁷⁻⁹⁹.

Throughout the GRE, we saw the substantial impacts acute disturbances can have on a reef. In the Red Sea, French Polynesia, Tonga, and the Solomon Islands, we saw evidence of COTS outbreaks, and in the Cook

Islands at Aitutaki, we witnessed an active outbreak. We removed over 600 individual COTS at Aitutaki and returned a two years later to help reassess the damage caused by the outbreak. After two years, we did not see substantial changes to the live coral cover, but this was expected as most coral communities take decades to recover.

Acute disturbances such as storms and tsunami damage are hard to mitigate but managing the reef in a way that reduces pressure from other factors such as overfishing and nutrient runoff can help aid in reef recovery.

4. MARINE PROTECTED AREAS WORK IN CONSERVING CORAL REEFS.

The GRE took place at a critical time. Shifts in the expanse of coral reefs and their unique habitats are imminent given the rapidly changing climate. The GRE highlighted that remote and undisturbed reefs had the best reef systems. The Gambier and Tuamotu Archipelagoes of French Polynesia and the Chagos Archipelago in the Indian Ocean had low human populations and, in the case of Chagos, the highest protection. These areas displayed some of the best reef systems with high coral cover and fish biomass and density and should be protected and preserved as these reefs may have the best chance of survival.

On the GRE, we were encouraged by countries such as Australia (N.GBR), Palau, and New Caledonia, which have large human populations utilizing the reefs, and have prioritized establishing large protected and managed areas to conserve their nearshore reef ecosystems. Described in more detail in the individual final country reports, in each of these cases, the sites with the strictest protections had the most stable reef ecosystems.

Strict no-take and no-entry zones have been proven to be successful in conserving coral reefs and the greatest example of this is the Chagos Archipelago. At the time of the research mission, the Chagos Archipelago had high

fish density, biomass, and coral cover and after previous large-scale disturbance events and had nearly full recovery within 10 years⁹⁴. Protecting remote reefs and using marine spatial planning to strategically place no-take, no-entry MPAs can help global coral reef resilience as the coral reef crisis shows no signs of slowing.

Currently, the foundation is using the maps and data collected on the GRE to develop a global coral reef resilience model that can be used by managers to help focus conservation efforts in areas where reefs have the highest chance of survival, given the rapidly changing climate. We are at a time where strong action is needed to conserve coral reefs, and are excited to share our resilience models with managers to help in prioritizing conservation efforts.

Strong action is needed to conserve coral reefs.

Figure 33

DRASTIC EFFORTS WILL BE NEEDED TO ADDRESS THE CORAL REEF CRISIS. ONE STEP IN THE RIGHT DIRECTION WAS TAKEN BY PALAU, WHICH PLEDGED TO EFFECTIVELY MANAGE AT LEAST 50% OF THEIR WATERS BY 2030. THEY ALREADY SUSTAINABLY MANAGE MUCH OF THEIR WATERS, SUCH AS THE ICONIC ROCK ISLANDS, PICTURED HERE.



5. COLLABORATION WITH LOCAL COMMUNITIES HAS THE BIGGEST IMPACT ON REEF CONSERVATION.

Aggressive management of the world's reefs will be key to their long-term survival. KSLOF found success in combining high-resolution habitat maps and working directly with local scientists and managers to establish large-scale conservation efforts. One of the biggest takeaways from the GRE was that nearly every community we worked with around the world expressed, and continues to express, the want and need for conservation of its reef systems. Working directly with the communities, sharing our findings, and expanding on their current management efforts has proven to be the most successful in conserving the reefs visited on the GRE. Our work on the GRE has been used to conserve reefs in The Bahamas, Fiji, and the Cook Islands.

Many communities we visited use traditional management tools to conserve their marine resources. The Cook Islands have revived customary management practices such as ra'ui to regulate fishing practices¹⁰¹, and since the time of our mission, they have expanded and designated their entire exclusive economic zone as an MPA and are working to improve their nearshore fisheries management¹⁰². While working in the Cook Islands, KSLOF partnered with local managers and planners by sharing our findings and maps to aid in the designation and implementation of the Marae Moana,

the Cook Islands Marine Park. Communities in the Lau Province of Fiji have also worked closely with KSLOF scientists to establish a locally recognized protected area and are currently working to have this become an internationally recognized MPA.

Palauans have practiced effective management to conserve their marine resources for thousands of years. Starting January 1, 2020, Palau designated over 475,000 km² as an MPA and has made huge strides in conservation by initiating the Micronesia Challenge, in which Palau partnered with neighboring countries to effectively manage at least 50% of its marine resources by 2030^{103,104}. Drastic measures such as these are critical in protecting the world's reefs against the coral reef crisis **(Figure 33)**.

The efforts and urgency of local communities provide much-needed hope that the world's reefs may survive the swift changes they are currently experiencing. KSLOF hopes our peer-reviewed publications and maps, our education and outreach materials, and the findings in this report and all of our country reports from the GRE, will continue to be used by local communities, governments, scientists, educators, and managers in the ongoing fight against the coral reef crisis and to preserve the world's coral reefs for generations to come.

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with ground transportation for participants, managed all logistics on the ship, and went above and beyond to ensure every participant on the ship was treated with exceptional care. They were responsible for getting us safely to our research sites, getting our education team safely to shore so they could work with communities around the world, and conducting all logistical operations of the dive and research vessels. They ensured that each researcher had access to the study sites and proper working tools and equipment needed to complete the work and had highly capable engineers and electricians who repaired and fabricated gear when we ran into complications. Behind the scenes, the crew worked at all hours to support all participants on the Global Reef Expedition, and for that, we are immensely grateful.

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APPENDIX 1

HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
<i>Acropora palmata</i> framework	-	-	10.29	-	-	-
<i>Acropora palmata</i> patch reefs	-	-	0.83	-	-	-
Back reef coral bommies	-	-	-	0.93	0.89	0.89
Back reef coral framework	-	-	-	18.19	5.64	6.54
Back reef pavement	-	-	-	14.11	96.11	15.28
Back reef rubble dominated	-	-	-	5.97	44.49	8.94
Back reef sediment dominated	-	-	-	29.35	7.62	27.88
Backreef coral	-	-	-	-	-	-
Basalt boulders	-	-	-	-	-	-
Basalt rock	-	-	-	-	-	-
Beach rock	-	0.16	-	-	-	-
Beach sand	-	0.71	-	1.38	1.53	1.41
Blue hole	0.46	-	-	-	-	-
Buried lagoonal coral framework	-	-	-	2.93	-	-
Carbonate blocks	-	-	-	0.29	-	1.56
Carbonate hardground and reef flats	-	-	-	-	-	-
Columnar frameworks	-	-	-	-	-	-
Coral framework	62.14	-	-	-	-	-

French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
0.47	0.34	11.95	-	-	-	1.50	-
5.33	37.44	37.89	-	-	-	15.16	-
6.14	25.58	120.47	-	-	-	55.68	-
2.85	34.20	29.41	-	-	-	49.14	-
8.36	89.74	98.37	-	-	-	23.81	-
-	-	-	-	41.59	-	-	13.53
-	-	-	0.82	-	-	-	-
-	-	-	60.78	-	-	-	-
-	-	-	-	-	-	-	-
3.14	5.35	29.36	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
10.72	-	54.86	-	-	-	-	-
-	-	-	-	-	273.91	-	-
-	-	-	-	-	618.58	-	-
-	-	-	0.09	-	-	-	-

APPENDIX 1

HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
Coral rubble	-	-	-	0.01	-	0.48
Coralline algal ridge	-	2.26	-	3.74	13.02	4.74
Cyanobacteria mats on sand	-	-	-	-	-	-
Deep fore reef slope	-	6.70	-	11.81	51.55	62.43
Deep lagoonal sands	-	-	-	-	-	-
Deep lagoonal water	-	401.09	-	27.23	589.87	-
Deep ocean water	-	61.40	-	-	-	-
Dense <i>Acropora</i> thickets	-	-	-	-	-	-
Dense macroalgae on sediment	-	0.01	-	-	1.40	-
Dense seagrass meadows	491.72	0.38	-	-	12.12	-
Eroded aeolian dunes	140.69	-	-	-	-	-
Eroded island surface	0.76	-	-	-	-	-
Fore reef sand flats	-	1.58	-	1.35	10.79	2.23
Gorgonian-dominated fore reef	-	-	20.30	-	-	-
Gorgonian-dominated hardground	202.85	-	277.53	-	-	-
Inland waters	-	0.02	-	0.07	0.06	-
Lagoonal <i>Acropora</i> framework	-	-	-	1.40	-	-
Lagoonal coral	-	-	-	-	-	-

	French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
	2.22	3.87	24.08	-	-	-	-	-
	3.41	7.80	17.98	-	-	-	-	-
	-	-	-	-	-	12.44	-	-
	15.52	18.03	3.85	-	108.60	-	52.91	70.51
	-	-	-	-	-	1,682.34	-	-
	140.78	233.91	3,389.13	-	1,053.91	-	-	1,114.00
	-	-	-	-	-	-	-	-
	-	-	-	-	-	25.36	-	-
	-	-	-	-	22.39	-	13.36	-
	-	-	-	-	3.37	-	7.17	17.65
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	7.28	0.01	-	-	37.54	-	20.60	32.89
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	3.72	0.02	-	-	-	0.04	-
	135.47	-	10.82	-	-	-	0.02	-
	-	-	-	-	77.71	-	-	73.57

APPENDIX 1

HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
Lagoonal coral framework	-	-	-	-	-	0.05
Lagoonal floor barren	-	17.69	-	45.19	210.26	61.96
Lagoonal floor coral bommies	-	0.05	-	1.12	3.40	2.45
Lagoonal floor macroalgae on sediment	-	-	-	0.53	0.94	13.11
Lagoonal fringing reefs	-	2.18	-	-	35.09	5.63
Lagoonal macroalgae dominated substrate	-	-	-	-	-	-
Lagoonal massive coral framework	-	-	-	8.87	-	-
Lagoonal <i>Orbicella</i> framework	-	-	68.99	-	-	-
Lagoonal patch reefs	-	2.83	-	2.26	1.62	3.17
Lagoonal pavement	-	-	-	-	-	0.94
Lagoonal pinnacle reefs branching coral dominated	-	9.30	-	-	-	0.43
Lagoonal pinnacle reefs calcareous red algal conglomerate	-	-	-	-	-	-
Lagoonal pinnacle reefs massive coral dominated	-	12.15	-	-	19.55	7.75
Lagoonal sediment apron macroalgae on sediment	-	-	-	-	0.13	-
Lagoonal sediment apron sediment dominated	-	-	-	-	11.26	-
Lagoonal substrate	-	-	-	-	-	-
Land	1,924.13	-	0.15	-	-	-

French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
-	-	-	-	-	-	-	-
162.84	45.42	771.43	-	-	-	198.27	-
2.52	0.05	10.35	-	-	-	1.59	-
1.89	0.09	8.51	-	-	-	-	-
12.46	23.89	-	-	-	-	76.34	-
-	-	-	-	68.66	-	-	7.74
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
3.49	1.23	11.03	-	-	-	6.06	-
-	-	-	-	-	-	-	-
-	1.54	-	-	-	-	8.50	-
-	-	-	-	-	-	5.97	-
-	18.12	31.66	-	-	-	60.47	-
0.44	-	0.36	-	-	-	4.57	-
2.82	7.42	8.50	-	-	-	30.05	-
-	-	-	-	434.08	-	-	260.81
-	-	-	121.80	-	-	-	-

APPENDIX 1

HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
Leeward coral crests	-	-	-	-	-	-
Macroalgae on sand	3.09	-	-	-	-	-
Macroalgae, sponges, sandy hardgrounds	-	-	-	-	-	-
Macroalgal-dominated hardground	13.34	-	227.62	-	-	-
Mangroves	-	0.65	-	-	3.18	-
Mangroves and nearshore vegetation	-	-	-	-	-	-
Moderate to dense macroalgae in sand	2.43	-	620.04	-	-	-
<i>Orbicella</i> framework fore reef	-	-	13.67	-	-	-
<i>Orbicella</i> patch reefs	-	-	4.80	-	-	-
Mud	-	-	-	0.05	0.53	-
Nearshore algal communities	-	-	-	-	-	-
Patch reef	9.01	-	-	-	-	-
Pleistocene surface with coral colonies	58.32	-	-	-	-	-
Reef crest	-	-	-	-	-	-
Reef walls and drop-offs	-	-	-	-	-	-
Reef top algal mats	-	-	-	-	-	-
Rock	-	-	-	1.20	-	-
Rubble fields	-	-	7.93	-	-	-

	French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
	-	-	-	-	-	127.69	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	174.65	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	32.91	4.27
	-	-	-	-	-	20.57	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	0.73	-	-	1.29	-	5.76	-
	-	-	-	-	8.12	-	-	19.73
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	7.63	-
	-	-	-	-	-	29.23	-	-
	-	0.06	0.37	-	2.58	-	-	-
	-	12.57	-	-	-	-	-	-
	-	-	-	-	-	-	-	-

APPENDIX 1

HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
Sand	74.91	-	-	-	-	-
Sand and mud flats	-	-	-	-	-	-
Sand with algae	-	-	-	-	-	-
Scoured channels	-	-	-	-	-	-
Scoured hardground	116.09	-	-	-	-	-
Seagrass meadows	-	-	-	-	-	-
Sediment apron	-	-	7.06	-	-	-
Shallow coral framework	16.77	-	11.44	-	-	-
Shallow fore reef community	-	-	-	-	-	-
Shallow fore reef slope	-	7.14	-	10.42	25.18	31.97
Shallow fore reef terrace	-	7.56	-	6.84	18.32	9.68
Shallow sand sheets	-	-	-	-	-	-
Shelf-edge coral framework	28.93	-	-	-	-	-
Soil	-	-	-	-	-	1.67
Sparse corals, rubble, and sand	-	-	-	-	-	-
Sparse to medium density seagrass	78.61	-	-	-	-	-
Submerged vegetation	-	-	-	-	-	-
Terrestrial vegetation	-	7.20	-	96.18	290.64	100.19

French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
-	-	-	27.48	-	-	-	-
-	-	-	-	-	365.65	-	-
-	-	-	5.14	-	-	-	-
-	-	-	-	-	3.06	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	67.53	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	105.14	-	-	79.71
40.44	16.13	61.91	-	-	-	54.18	-
10.15	11.78	26.19	-	-	-	48.88	-
-	-	-	-	-	3,226.58	-	-
-	-	-	-	-	-	-	-
1.86	4.09	-	-	-	-	-	-
-	-	-	-	-	579.47	-	-
-	-	-	-	-	-	-	-
-	-	-	0.02	-	-	-	-
34.22	343.02	86.38	-	267.15	-	559.14	206.91

APPENDIX 1 | HABITAT MAPPED BY AREA (KM²)

Habitat Classifications	Bahamas	Peros Banhos, Chagos Archipelago	Colombia	Cook Islands	Lau Province, Fiji	French Polynesia, Austral Archipelago
Turf-algal-dominated hardground	4.02	-	-	-	-	-
Unconsolidated sand sheets	-	-	458.92	-	-	-
Unvegetated terrestrial	-	-	-	0.17	26.09	-
Urban	-	-	-	3.55	0.61	2.71
Wetlands	-	0.30	-	-	-	-
Windward coral crests	-	-	-	-	-	-

	French Polynesia, Gambier Archipelago	French Polynesia, Society Archipelago	French Polynesia, Tuamotu Archipelago	Galapagos Islands	New Caledonia	Saudi Arabia	Solomon Islands	Tonga
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	12.14	-
	0.44	10.32	2.57	-	0.35	-	1.52	2.46
	-	-	-	-	-	-	-	-
	-	-	-	-	-	127.43	-	-

APPENDIX 2

DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	1	16.91612	42.29254	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	2	16.92904	42.28852	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	3	16.89894	42.25025	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	4	17.07091	41.93261	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	5	17.09743	41.91989	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	6	17.06367	41.90481	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	7	17.08736	41.91079	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	8	17.00145	41.36283	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	9	16.94038	41.35460	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	10	16.73097	41.78627	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	11	16.74176	41.74350	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	12	16.69473	41.82946	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	13	16.70569	41.80913	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	14	16.63576	41.88818	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	15	16.63294	41.87719	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	16	16.81433	41.54255	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	17	16.89461	41.56198	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	18	16.86874	41.44787	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	19	16.79890	41.51369	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	20	16.80602	41.62758	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	21	16.80747	41.61946	May 2006
Red Sea	Kingdom of Saudi Arabia	Farasan Islands	22	16.55966	42.23502	May 2006

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	1	28.049800	34.984300	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	2	28.045600	34.987500	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	3	28.094100	34.996800	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	4	28.019100	34.961700	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	5	27.996500	35.010900	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	6	28.002900	35.007900	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	7	27.993000	34.951900	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	8	27.996500	34.998200	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	9	27.973300	35.147500	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	10	27.979600	35.154300	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	11	28.067000	35.095600	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	12	28.014900	35.111900	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	13	27.962300	35.149300	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	14	27.883200	35.221700	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	15	27.898400	35.168800	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	16	27.923500	35.241400	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	17	27.923300	35.238000	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	18	27.894200	35.073300	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Ras Al-Qasabah	19	27.903300	35.082600	Sept 2007
Red Sea	Kingdom of Saudi Arabia	Al Wajh	1	25.410930	36.823370	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	2	25.359050	36.883830	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	3	25.404270	36.952460	May 2008

APPENDIX 2

DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Al Wajh	4	25.641990	36.479300	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	5	25.581810	36.547780	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	6	25.568170	36.684450	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	7	25.559070	36.824010	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	8	25.523890	36.835330	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	9	25.565400	36.629300	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	10	25.649640	36.695530	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	11	25.604590	36.683010	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	12	25.761020	36.577790	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	13	25.835790	36.599550	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	14	25.815220	36.538970	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	15	25.877004	36.591466	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	16	25.866670	36.608060	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	17	25.805480	36.659600	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	18	25.817110	36.600350	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	19	25.392830	36.687410	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	20	25.330060	36.768950	May 2008
Red Sea	Kingdom of Saudi Arabia	Al Wajh	21	35.339888	36.762017	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	1	23.181700	38.720340	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	2	23.173280	38.679780	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	3	23.431130	38.539210	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	4	23.454900	38.539890	May 2008

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Yanbu	5	23.875423	38.205989	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	6	23.855330	38.241910	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	7	23.836960	38.164420	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	8	23.682880	38.324170	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	9	23.701890	38.344370	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	10	23.829240	38.274140	May 2008
Red Sea	Kingdom of Saudi Arabia	Yanbu	11	23.840210	38.132580	May 2008
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	1	19.98585	40.11390	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	2	19.95083	40.15405	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	3	19.97410	39.94327	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	4	19.97135	39.95163	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	5	19.93499	39.99026	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	6	19.84162	39.92428	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	7	19.84000	39.93333	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	8	19.77177	40.20365	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	9	19.79441	40.14799	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	10	19.73251	40.14767	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	11	19.75891	40.26950	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	12	19.76498	40.29776	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	13	19.75843	40.31802	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	14	19.64091	40.30381	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	15	19.63983	40.05317	April 2009

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	16	19.64205	40.04946	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	17	19.70419	40.30751	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	18	19.66434	40.43226	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	19	19.67330	40.44167	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	20	19.61684	40.40340	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	21	19.53389	40.11900	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	22	19.52500	40.12940	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	23	19.65140	40.23876	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	24	19.59761	40.24142	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	25	19.66434	40.43226	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	26	19.66420	40.44222	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	27	19.60009	40.63850	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	28	19.48476	40.72180	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	29	19.24685	40.97718	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	30a	19.24748	40.98206	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	30b	19.28833	40.98666	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	30c	19.24833	40.98166	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	31	19.19353	40.71233	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	32	19.15886	40.53606	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	33	19.12629	40.58944	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	34	19.17681	40.72295	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	35	19.01122	40.60947	April 2009

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	36	19.00666	40.62473	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	37	19.14720	40.68010	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	38	19.06971	40.61148	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	39	19.05488	40.63392	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	40	19.21296	40.70494	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	41	19.23090	40.52824	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	42	19.21110	40.62551	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	43	19.21129	40.70736	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	44	18.81185	40.84597	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	45	18.86103	40.70445	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	46	18.85695	40.71630	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	47	18.93308	40.78437	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	48	18.86361	40.81184	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	49	18.86317	40.80553	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	50	18.86361	40.81184	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	51	18.60553	41.06599	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	52	18.76667	41.04833	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	53	18.74029	41.01057	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	54	18.57837	41.07859	April 2009
Red Sea	Kingdom of Saudi Arabia	Farasan Banks	55	18.86454	40.38068	April 2009
Caribbean	The Bahamas	Andros Shelf	AN-01	23.56202	-77.32854	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-02	23.55205	-77.33203	October 2011

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	The Bahamas	Andros Shelf	AN-03	23.58253	-77.33286	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-04	23.60288	-77.34055	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-05	23.67619	-77.37133	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-06	23.72853	-77.39325	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-07	23.78030	-77.41680	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-08	25.39198	-77.82326	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-09	25.39158	-77.82007	October 2011
Caribbean	The Bahamas	Andros Shelf	AN-10	25.43290	-78.00849	October 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-01	23.55521	-79.57055	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-02	23.58089	-79.59282	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-03	23.59069	-79.60298	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-04	23.42404	-79.57460	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-05	23.43012	-79.65046	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-06	23.60639	-79.61355	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-07	23.74519	-79.68191	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-08	23.69257	-79.65529	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-09	23.64930	-79.61062	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-10	23.86417	-79.80456	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-11	23.89696	-79.80958	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-12	23.83794	-79.74358	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-13	23.81405	-79.72993	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-14	23.72230	-79.95085	April-May 2011

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	The Bahamas	Cay Sal Bank	CSB-15	24.01154	-79.80262	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-16	23.95870	-79.79111	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-17	23.88732	-79.76373	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-18	24.01195	-79.81213	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-19	23.99049	-79.80727	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-20	24.03841	-79.95461	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-21	24.04608	-79.96050	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-22	24.04664	-80.11508	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-23	23.96898	-80.38522	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-24	24.00787	-80.30127	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-25	23.91085	-80.48680	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-26	23.93244	-80.47313	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-27	23.95722	-80.44592	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-28	23.92997	-80.47625	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-29	23.85814	-80.49263	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-30	23.77863	-80.47765	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-31	23.79921	-80.47932	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-32	23.81126	-80.47852	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-33	23.68629	-80.40205	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-34	23.78584	-80.27232	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-35	23.64939	-80.18733	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-36	23.49485	-79.89154	April-May 2011

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	The Bahamas	Cay Sal Bank	CSB-37	23.48346	-79.85194	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-38	23.49066	-79.87989	April-May 2011
Caribbean	The Bahamas	Cay Sal Bank	CSB-39	23.49395	-79.88530	April-May 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-01	21.11241	-73.67271	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-02	21.13884	-73.57152	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-03	21.12559	-73.65472	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-04	21.13290	-73.61866	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-05	21.08957	-73.65251	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-06	21.02854	-73.69021	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-07	21.01152	-73.70364	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-08	20.97379	-73.68474	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-09	21.03189	-73.66754	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-10	21.03934	-73.65972	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-11	21.17747	-73.52147	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-12	21.19241	-73.43532	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-13	20.89164	-73.12965	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-14	20.94855	-73.15150	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-15	20.93535	-73.20407	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-16	21.00912	-73.12897	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-17	20.95075	-73.24772	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-18	20.92930	-73.38667	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	GI-19	21.08023	-73.64886	August 2011

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	The Bahamas	Great Inagua Shelf	LI-01	21.48096	-73.07515	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	LI-02	21.51139	-73.07539	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	LI-03	21.50169	-73.08015	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	LI-04	21.43566	-73.05491	August 2011
Caribbean	The Bahamas	Great Inagua Shelf	LI-05	21.54370	-73.01575	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-01	21.70200	-73.84700	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-02	21.69500	-73.85200	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-03	21.69210	-73.76202	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-04	21.70448	-73.78361	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-05	21.70942	-73.81771	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-06	21.67358	-73.79047	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-07	21.66686	-73.81847	August 2011
Caribbean	The Bahamas	North Inagua Shelf	HR-08	21.68317	-73.81777	August 2011
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-01	16.01037	-79.32291	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-02	16.02593	-79.29423	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-03	16.01540	-79.30450	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-04	16.06520	-79.29410	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-05	16.08638	-79.29887	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-06	16.09838	-79.29893	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-07	16.05280	-79.29040	April 2012

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-08	16.10570	-79.30490	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COAL-09	16.10680	-79.30870	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-10	15.89660	-78.65770	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-11	15.89080	-78.64640	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-12	15.88270	-78.65160	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-13	15.84350	-78.67990	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-14	15.82080	-78.73930	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-15	15.86180	-78.68070	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-16	15.84760	-78.71100	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-25	15.89460	-78.62660	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-26	15.92650	-78.59350	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-27	15.87650	-78.61990	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-28	15.91250	-78.56710	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-29	15.90370	-78.57220	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-30	15.90830	-78.57710	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-31	15.82770	-78.67890	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	CONU-32	15.87610	-78.64170	April 2012

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-17	15.85760	-79.81270	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-18	15.81990	-79.84400	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-19	15.83890	-79.83340	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-20	15.87080	-79.86780	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-21	15.79140	-79.84990	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-22	15.90390	-79.69770	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-23	15.87030	-79.87060	April 2012
Caribbean	Colombia	Eastern Colombia-Caribbean Shelf	COSE-24	15.87870	-79.86840	April 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-01	17.00640	-77.81349	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-02	16.93884	-77.83963	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-03	16.93192	-77.79698	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-04	17.04509	-77.76067	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-06	17.03978	-77.68607	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-07	17.04917	-77.72060	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-08	16.97170	-77.79070	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-09	17.00256	-77.78744	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-10	16.93080	-77.91980	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-11	16.83950	-78.08710	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-12	16.84350	-78.10010	March 2012

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-13	16.88980	-77.99265	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-14	17.04736	-77.51462	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-15	17.03267	-77.53016	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-16	16.93983	-77.57468	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-17	16.95351	-78.66334	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-18	16.86968	-78.10248	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-19	16.98122	-77.79603	March 2012
Caribbean	Jamaica	Pedro Bank Shelf	JAPB-20	16.93890	-77.82957	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-01	18.41420	-75.01600	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-02	18.41400	-75.02400	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-03	18.38910	-75.01766	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-04	18.41609	-75.02541	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-05	18.40362	-75.02430	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-06	18.39626	-75.02397	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-07	18.39145	-75.02245	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-08	18.39393	-75.02166	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-09	18.39250	-75.01420	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-10	18.41413	-75.01212	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-11	18.39730	-75.02060	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-12	18.40010	-75.02248	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-13	18.41000	-75.03060	March 2012
Caribbean	Navassa	South Haiti Shelf	NAV-14	18.40860	-75.02870	March 2012

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	Navassa	South Haiti Shelf	NAV-15	18.39638	-75.01888	March 2012
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-01	17.23254	-62.58743	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-02	17.22024	-62.57822	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-03	17.21232	-62.65492	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-04	17.18156	-62.68222	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-05	17.18605	-62.68056	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-06	17.25531	-62.71649	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-07	17.09406	-62.62101	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-08	17.08571	-62.59632	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-09	17.16554	-62.63558	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-10	17.35471	-62.85279	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-11	17.37352	-62.86853	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-12	17.42522	-62.81744	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-13	17.38081	-62.71470	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-14	17.39351	-62.73745	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-15	17.42129	-62.80548	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-16	17.35665	-62.85536	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-17	17.31224	-62.79892	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-18	17.28392	-62.74776	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-19	17.26386	-62.72036	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-20	17.26093	-62.72467	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-21	17.18199	-62.63269	June 2011

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-22	17.22258	-62.66441	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-23	17.26589	-62.68679	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-24	17.31331	-62.66471	June 2011
Caribbean	St. Kitts and Nevis	Saba Shelf	STK-25	17.27659	-62.62533	June 2011
Indian Ocean	Chagos Archipelago	Blenheim	BIBL82	-5.2543	72.4572	March-May 2015
Indian Ocean	Chagos Archipelago	Blenheim	BIBL83	-5.2186	72.4926	March-May 2015
Indian Ocean	Chagos Archipelago	Blenheim	BIBL86	-5.1780	72.4571	March-May 2015
Indian Ocean	Chagos Archipelago	Blenheim	BIBL87	-5.2320	72.4431	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG02	-6.6671	71.3909	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG03	-6.6939	71.3786	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG04	-6.6475	71.3684	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG05	-6.6425	71.3112	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG06	-6.6394	71.3395	March-May 2015
Indian Ocean	Chagos Archipelago	Egmont	BIEG07	-6.6673	71.3681	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- North	BINI77	-5.7059	72.3241	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- North	BINI78	-5.6805	72.3815	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- North	BINI79	-5.6890	72.3225	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- North	BINI80	-5.7125	72.0457	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BICC35	-6.1839	71.6403	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BICC36	-6.2321	71.5883	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BICC50	-6.3995	71.6173	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BICC51	-6.3002	71.5696	March-May 2015

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Indian Ocean	Chagos Archipelago	GCB- West	BIDI08	-6.3942	71.2341	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI09	-6.3793	71.2336	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI10	-6.3908	71.2462	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI12	-6.4534	71.2337	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI13	-6.4611	71.2439	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI14	-6.4099	71.2562	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI15	-6.3531	71.2358	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIDI16	-6.3409	71.2567	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA17	-6.1810	71.3483	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA18	-6.2024	71.4042	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA19	-6.2020	71.3588	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA20	-6.1899	71.3633	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA22	-6.2766	71.2763	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA23	-6.2422	71.2906	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA24	-6.2096	71.3043	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA25	-6.1907	71.3184	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA26	-6.1722	71.3319	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BIEA52	-6.1988	71.4931	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB27	-6.1562	71.5099	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB28	-6.1384	71.5091	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB29	-6.1346	71.4980	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB30	-6.1640	71.5321	March-May 2015

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Indian Ocean	Chagos Archipelago	GCB- West	BITB32	-6.1715	71.5934	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB33	-6.1793	71.5813	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB34	-6.1694	71.5464	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB37	-6.1770	71.5440	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB38	-6.1683	71.5404	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB39	-6.1715	71.5349	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB40	-6.1481	71.5285	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB41	-6.0300	71.5490	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB42	-6.0576	71.5213	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB43	-6.1053	71.4988	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB44	-6.0398	71.5508	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB45	-6.0508	71.5350	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB46	-6.0961	71.5143	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB47	-6.0266	71.6164	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB48	-6.0679	71.6752	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB49	-6.1103	71.6547	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB53	-6.1268	71.5032	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB54	-6.1660	71.5268	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB55	-6.1753	71.5397	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB56	-6.1857	71.5661	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB57	-6.1598	71.5271	March-May 2015
Indian Ocean	Chagos Archipelago	GCB- West	BITB58	-6.1479	71.5241	March-May 2015

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB110	-5.3175	71.9224	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB112	-5.2373	71.9620	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB114	-5.2572	71.9758	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB60	-5.4434	71.7499	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB61	-5.3912	71.7497	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB62	-5.4272	71.7778	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB63	-5.4152	71.7750	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB64	-5.4624	71.8244	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB65	-5.4108	71.8035	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB66	-5.3813	71.7518	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB67	-5.2810	71.7350	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB68	-5.2563	71.7686	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB69	-5.2964	71.7670	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB70	-5.3252	71.8574	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB71	-5.2551	71.8139	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB72	-5.2761	71.8866	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB73	-5.2673	71.8886	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB74	-5.2611	71.9518	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB75	-5.3050	71.9790	March-May 2015
Indian Ocean	Chagos Archipelago	Peros Banhos	BIPB76	-5.3377	71.9806	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA102	-5.3694	72.2138	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA103	-5.3490	72.2687	March-May 2015

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA104	-5.3083	72.2687	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA105	-5.3343	72.2431	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA106	-5.3443	72.2039	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA107	-5.3102	72.2689	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA84	-5.3173	72.2241	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA88	-5.3393	72.2361	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA91	-5.3397	72.2633	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA92	-5.3289	72.2800	March-May 2015
Indian Ocean	Chagos Archipelago	Salomon Atoll	BISA93	-5.2993	72.2579	March-May 2015
Indian Ocean	Chagos Archipelago	Salomons Island	BISA94	-5.3504	72.2200	March-May 2015
Indian Ocean	Chagos Archipelago	Salomons Island	BISA97	-5.3168	72.2373	March-May 2015
Indian Ocean	Chagos Archipelago	Salomons Island	BISA98	-5.3242	72.2190	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP100	-4.7843	72.3445	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP101	-4.7925	72.3456	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP115	-4.9195	72.4370	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP89	-4.9518	72.3830	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP90	-4.9505	72.4122	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP95	-5.0499	72.2873	March-May 2015
Indian Ocean	Chagos Archipelago	Speakers Bank	BISP96	-4.9659	72.2362	March-May 2015
Indian Ocean	Chagos Archipelago	Victory Bank	BIVB108	-5.5265	72.2265	March-May 2015
Indian Ocean	Chagos Archipelago	Victory Bank	BIVB109	-5.5476	72.2188	March-May 2015
Indian Ocean	Chagos Archipelago	Victory Bank	BIVB81	-5.5344	72.2159	March-May 2015

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Indian Ocean	Chagos Archipelago	Victory Bank	BIVB99	-5.5310	72.2451	March-May 2015
Pacific Ocean	Cook Islands	Aitutaki	CIAT13	-18.9043	-159.7236	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT14	-18.8184	-159.7735	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT15	-18.8897	-159.8272	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT16	-18.8672	-159.8188	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT17	-18.8331	-159.7941	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT18	-18.9173	-159.8452	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT19	-18.8517	-159.8054	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT20	-18.9283	-159.7943	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT21	-18.9519	-159.7445	April-May 2013
Pacific Ocean	Cook Islands	Aitutaki	CIAT22	-18.9271	-159.7250	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA23	-17.9926	-163.1535	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA24	-18.0291	-163.1178	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA25	-18.0489	-163.1128	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA26	-18.0885	-163.1521	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA27	-18.0697	-163.1293	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA28	-18.0412	-163.1876	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA29	-18.0057	-163.1757	April-May 2013
Pacific Ocean	Cook Islands	Palmerston	CIPA30	-18.0790	-163.1817	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR02	-21.2513	-159.8290	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR03	-21.2136	-159.8331	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR04	-21.2417	-159.7225	April-May 2013

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Cook Islands	Raratonga	CIRR05	-21.2136	-159.7330	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR06	-21.1993	-159.7569	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR07	-21.2642	-159.8165	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR08	-21.2745	-159.7725	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR09	-21.2719	-159.7299	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR10	-21.2007	-159.7714	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR11	-21.2300	-159.8335	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR12	-21.1935	-159.7965	April-May 2013
Pacific Ocean	Cook Islands	Raratonga	CIRR01	-21.1941	-159.8091	April-May 2013
Pacific Ocean	French Polynesia-Austral Archipelago	MariaOeste	AUMA26	-21.8130	-154.6891	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	MariaOeste	AUMA27	-21.7901	-154.7037	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	MariaOeste	AUMA28	-21.8200	-154.7239	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	MariaOeste	AUMA29	-21.7972	-154.6917	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	MariaOeste	AUMA30	-21.8008	-154.7180	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV01	-23.8605	-147.7151	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV02	-23.8902	-147.7208	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV03	-23.8318	-147.6574	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV04	-23.8282	-147.5901	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV05	-23.8339	-147.6291	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV06	-23.8962	-147.7123	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV07	-23.9123	-147.6609	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Raivavae	AURV08	-23.9108	-147.6843	April 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Austral Archipelago	Rimatara	AURM21	-22.6406	-152.8223	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rimatara	AURM22	-22.6665	-152.7958	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rimatara	AURM23	-22.6440	-152.7882	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rimatara	AURM24	-22.6648	-152.8163	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rimatara	AURM25	-22.6592	-152.7891	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rurutu	AURR18	-22.4522	-151.3235	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rurutu	AURR19	-22.4323	-151.3760	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Rurutu	AURR20	-22.5204	-151.3327	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB09	-23.4213	-149.4402	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB10	-23.3827	-149.5493	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB11	-23.4253	-149.5184	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB12	-23.4251	-149.4057	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB13	-23.3786	-149.3853	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB14	-23.3339	-149.4361	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB15	-23.3485	-149.5313	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB16	-23.3561	-149.5518	April 2013
Pacific Ocean	French Polynesia-Austral Archipelago	Tubuai	AUTB17	-23.4242	-149.4837	April 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG33	-23.0977	-135.0399	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG34	-23.0975	-135.0346	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG35	-23.1589	-134.9639	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG36	-23.0144	-134.9723	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG37	-23.0566	-134.9989	January-February 2013

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG38	-23.1440	-135.0968	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG39	-23.1911	-135.0927	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG40	-23.1780	-135.0923	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG41	-23.1697	-135.0608	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG42	-23.1489	-134.8460	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG43	-23.1374	-134.9014	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG44	-23.1890	-134.9030	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG45	-23.2164	-134.8582	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG46	-23.2241	-134.9646	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG47	-23.1548	-135.0189	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG48	-23.1675	-134.9306	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG49	-23.1763	-134.9023	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG50	-23.2017	-134.9234	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG51	-23.2360	-134.9014	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG52	-23.0791	-135.0039	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG53	-23.1694	-135.0322	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG54	-23.1418	-134.9174	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG55	-23.2607	-134.9958	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG56	-23.0776	-134.8884	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG57	-23.1104	-134.8464	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG58	-23.1772	-134.8436	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG59	-23.1691	-134.8591	January-February 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG60	-23.0711	-134.9108	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG61	-23.1984	-134.8733	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG62	-23.1271	-134.9097	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG63	-23.1451	-134.8559	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG70	-23.1973	-135.0646	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Mangareva	GAMG71	-23.1690	-135.1252	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maria Est	GAME30	-22.0175	-136.2081	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maria Est	GAME31	-22.0228	-136.1779	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maria Est	GAME32	-21.9928	-136.1895	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maturei Vavao	GAMV27	-21.4817	-136.3659	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maturei Vavao	GAMV28	-21.4445	-136.4037	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Maturei Vavao	GAMV29	-21.4841	-136.4157	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE64	-23.3158	-134.4848	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE65	-23.3574	-134.4934	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE66	-23.3290	-134.5060	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE67	-23.3436	-134.4620	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE68	-23.3248	-134.4751	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Temoe	GATE69	-23.3152	-134.4956	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenararo	GATR18	-21.3079	-136.7322	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenararo	GATR19	-21.3135	-136.7548	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenararo	GATR20	-21.2967	-136.7591	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenarunga	GATG24	-21.3562	-136.5310	January-February 2013

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenarunga	GATG25	-21.3518	-136.5610	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Tenarunga	GATG26	-21.3276	-136.5391	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Vahanga	GAVA21	-21.3150	-136.6555	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Vahanga	GAVA22	-21.3375	-136.6714	January-February 2013
Pacific Ocean	French Polynesia-Gambier Archipelago	Vahanga	GAVA23	-21.3340	-136.6328	January-February 2013
Pacific Ocean	French Polynesia-Society Archipelago	Bellinghausen	FPBE15	-15.7968	-154.5277	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Bellinghausen	FPBE16	-15.7986	-154.5135	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Bellinghausen	FPBE17	-15.8171	-154.5463	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU21	-16.6904	-150.9835	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU22	-16.7173	-151.0490	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU23	-16.7692	-151.0458	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU24	-16.7682	-150.9596	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU25	-16.7976	-151.0136	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU26	-16.7363	-151.0572	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Huahini	FPHU27	-16.7476	-151.0484	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Maiao	FPMA59	-17.6489	-150.6498	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Maiao	FPMA60	-17.6315	-150.6356	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Maiao	FPMA61	-17.6361	-150.6252	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Maiao	FPTA57	-16.5527	-151.4982	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Moorea	MMMO32	-17.4828	-149.9020	March 2013
Pacific Ocean	French Polynesia-Society Archipelago	Moorea	MMMO33	-17.4848	-149.8672	March 2013
Pacific Ocean	French Polynesia-Society Archipelago	Moorea	MMMO34	-17.4986	-149.9278	March 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO01	-16.7856	-153.9803	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO02	-16.7733	-153.9703	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO03	-16.8031	-153.9937	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO04	-16.7721	-153.9689	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO05	-16.7862	-153.9697	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO06	-16.8154	-153.9952	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO07	-16.7811	-153.9768	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Mopelia	FPMO08	-16.8205	-153.9530	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA33	-16.8329	-151.4962	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA34	-16.8986	-151.4718	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA35	-16.8746	-151.4938	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA36	-16.8950	-151.4921	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA37	-16.9173	-151.4675	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA38	-16.8064	-151.4992	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA39	-16.8479	-151.4952	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA41	-16.9198	-151.4602	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA42	-16.8794	-151.4759	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA43	-16.9095	-151.4196	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA44	-16.9157	-151.4135	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA45	-16.8251	-151.3479	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA46	-16.9027	-151.4282	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA47	-16.9220	-151.4817	September-October 2012

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA48	-16.9340	-151.4582	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA49	-16.9313	-151.4761	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA50	-16.8502	-151.3328	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA51	-16.7901	-151.3765	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA52	-16.8066	-151.3638	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA53	-16.7032	-151.4385	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA54	-16.7650	-151.4004	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA55	-16.8135	-151.3778	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Raiatea	FPRA58	-16.8011	-151.3847	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC09	-16.5683	-154.7337	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC10	-16.5362	-154.7325	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC11	-16.4885	-154.7123	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC12	-16.4940	-154.6603	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC13	-16.4789	-154.6907	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Scilly	FPSC14	-16.5081	-154.7291	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahaa	FPTA28	-16.7036	-151.4828	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahaa	FPTA29	-16.6250	-151.5799	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahaa	FPTA30	-16.5717	-151.5520	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahaa	FPTA31	-16.6814	-151.5255	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahaa	FPTA56	-16.5627	-151.4461	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahiti	SOTH01	-17.4988	-149.5041	November-December 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahiti	SOTH02	-17.7887	-149.4195	November-December 2012

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Society Archipelago	Tahiti	SOTH03	-17.7786	-149.4332	November-December 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahiti	SOTH04	-17.7808	-149.4228	November-December 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tahiti	SOTH05	-17.6924	-149.5912	November-December 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tetiaroa	FPTE62	-16.9852	-149.5829	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tetiaroa	FPTE63	-17.0042	-149.5931	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tetiaroa	FPTE64	-16.9816	-149.5671	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tupai	FPTU18	-16.2588	-151.7954	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tupai	FPTU19	-16.2836	-151.8361	September-October 2012
Pacific Ocean	French Polynesia-Society Archipelago	Tupai	FPTU20	-16.2285	-151.8300	September-October 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Aratika	TUAR15	-15.4902	-145.5865	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Aratika	TUAR16	-15.4633	-145.5712	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Aratika	TUAR17	-15.5934	-145.5610	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Aratika	TUAR18	-15.6273	-145.5187	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Aratika	TUAR19	-15.6230	-145.4911	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK32	-16.0741	-145.7056	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK33	-16.0514	-145.6568	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK34	-16.1877	-145.8216	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK35	-16.1523	-145.8247	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK36	-16.1240	-145.8150	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK38	-16.0469	-145.6355	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK39	-16.1037	-145.7856	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TUFK40	-16.0834	-145.6942	November-December 2012

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK41	-16.2338	-145.6738	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK42	-16.2438	-145.6423	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK43	-16.2415	-145.6284	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK44	-16.2895	-145.7363	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK45	-16.2845	-145.7037	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK46	-16.3018	-145.6200	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK47	-16.4456	-145.5296	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK48	-16.5035	-145.4627	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK49	-16.5320	-145.4650	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK50	-16.4410	-145.3622	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK51	-16.5167	-145.4553	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK53	-16.3670	-145.6734	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Fakarava	TU FK54	-16.2817	-145.5584	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA01	-18.0653	-140.9966	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA02	-18.0695	-141.0102	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA03	-18.0759	-141.0055	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA04	-18.1730	-141.0480	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA05	-18.0826	-141.0680	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA06	-18.0632	-140.9876	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA07	-18.3069	-140.9068	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA08	-18.0729	-141.0197	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TU HA09	-18.1157	-141.0490	November-December 2012

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA10	-18.3901	-140.7982	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA11	-18.3806	-140.7674	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA12	-18.3040	-140.8639	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA13	-18.3503	-140.8144	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA14	-18.3418	-140.8414	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA15	-18.3452	-140.8609	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA16	-18.0642	-140.9526	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Hao	TUHA17	-18.0958	-140.9095	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA01	-15.1270	-147.9418	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA02	-15.0886	-147.9428	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA03	-14.9792	-147.6160	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA04	-15.1656	-147.9089	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA05	-15.0561	-147.9392	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA06	-15.0113	-147.9093	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA07	-14.9762	-147.8772	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA08	-14.9151	-147.8344	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA09	-14.9555	-147.6449	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA10	-15.2359	-147.6532	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA11	-15.2556	-147.5754	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA12	-15.2362	-147.7561	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA13	-14.9481	-147.6703	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA14	-14.9898	-147.5970	March 2013

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA16	-14.9295	-147.7640	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA17	-14.9826	-147.6346	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA18	-15.0137	-147.5730	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA19	-14.9721	-147.6221	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA20	-15.0048	-147.5792	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA21	-15.0262	-147.5650	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA22	-15.0015	-147.8808	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA23	-14.9344	-147.7090	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA24	-14.9615	-147.6318	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA25	-15.0467	-147.5406	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA26	-14.9417	-147.6896	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA27	-15.1447	-147.4247	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA28	-15.1040	-147.4769	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA29	-14.9200	-147.8015	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA30	-14.9684	-147.6247	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	MMRA31	-15.2364	-147.2797	March 2013
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA06	-14.9723	-147.6221	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA07	-14.9554	-147.7099	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA08	-15.0192	-147.7572	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA09	-14.9321	-147.8594	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA10	-14.9567	-147.8670	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA11	-14.9562	-147.7880	November-December 2012

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA12	-15.1409	-147.8095	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA13	-15.1987	-147.7607	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Rangiroa	TURA14	-14.9351	-147.7060	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK21	-16.2701	-144.9073	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK22	-16.2871	-144.8584	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK23	-16.0889	-144.9563	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK24	-16.0956	-144.9539	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK25	-16.1171	-145.0056	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK26	-16.0944	-144.9525	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK27	-16.1117	-144.8296	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK28	-16.0970	-144.8640	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK29	-16.0884	-144.9393	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK30	-16.2518	-144.8106	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Raraka	TURK31	-16.2020	-144.7741	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO56	-15.9293	-145.9535	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO57	-15.9289	-145.9903	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO58	-15.9065	-145.8987	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO59	-15.9135	-145.8888	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO60	-15.9120	-145.8955	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO61	-15.8982	-145.9108	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO62	-15.8907	-146.0718	November-December 2012
Pacific Ocean	French Polynesia-Tuamotu Archipelago	Toau	TUTO63	-15.8859	-146.0357	November-December 2012

APPENDIX 2

DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Galapagos Islands	Baltra	GABA13	-0.4710	-90.2549	June 2012
Pacific Ocean	Galapagos Islands	Baltra	GABA14	-0.4819	-90.2527	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA04	1.6760	-91.9948	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA05	1.6760	-91.9937	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA08	1.6772	-91.9938	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA09	1.6751	-91.9925	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA10	1.6761	-92.0080	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA11	1.6772	-91.9947	June 2012
Pacific Ocean	Galapagos Islands	Darwin	GADA12	1.6730	-91.9890	June 2012
Pacific Ocean	Galapagos Islands	Wolf	GAWO07	1.6758	-91.9952	June 2012
Pacific Ocean	Galapagos Islands	Florena	GAFL17	-1.2160	-90.4235	June 2012
Pacific Ocean	Galapagos Islands	Florena	GAFL18	-1.2382	-90.3879	June 2012
Pacific Ocean	Galapagos Islands	Florena	GAFL19	-1.2368	-90.4063	June 2012
Pacific Ocean	Galapagos Islands	Marchena	GAMA01	0.3122	-90.4015	June 2012
Pacific Ocean	Galapagos Islands	Santa Cruz	GASC15	-0.7003	-89.2462	June 2012
Pacific Ocean	Galapagos Islands	Urvina	GAUR23	-0.3927	-91.2665	June 2012
Pacific Ocean	Galapagos Islands	Wolf	GAWO02	1.3873	-91.8168	June 2012
Pacific Ocean	Galapagos Islands	Wolf	GAWO03	1.3856	-91.8146	June 2012
Pacific Ocean	Galapagos Islands	Wolf	GAWO06	1.3850	-91.8133	June 2012
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA01	-19.8064	-174.3803	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA02	-19.7979	-174.3845	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA03	-19.8561	-174.4268	September 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA04	-19.8668	-174.4824	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA05	-19.8198	-174.4426	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA06	-19.9850	-174.5085	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA07	-20.0581	-174.4856	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA08	-20.0668	-174.5032	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA09	-20.0714	-174.5074	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA10	-20.0566	-174.5468	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA11	-19.9271	-174.8158	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA12	-19.9155	-174.8055	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA13	-19.9071	-174.7584	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA14	-20.0938	-174.7885	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA15	-20.0817	-174.7574	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA16	-20.0600	-174.6799	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA17	-19.9261	-174.7279	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA18	-20.0016	-174.7918	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA19	-19.9478	-174.6852	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA20	-20.0623	-174.6646	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA21	-19.8148	-174.7138	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA22	-19.7542	-174.6488	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA23	-19.8429	-174.5321	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA24	-19.8334	-174.3369	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA25	-19.8923	-174.3881	September 2013

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA26	-19.8413	-174.5209	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA27	-19.7457	-174.3773	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA28	-19.7176	-174.4283	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA29	-19.6711	-174.4013	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA30	-19.5992	-174.4702	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA31	-19.6309	-174.4875	September 2013
Pacific Ocean	Kingdom of Tonga	Ha'apai	TOHA32	-19.6430	-174.4929	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI54	-15.9819	-173.7913	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI55	-15.9751	-173.8108	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI56	-15.9380	-173.8299	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI57	-15.9256	-173.7670	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI58	-15.9329	-173.7977	September 2013
Pacific Ocean	Kingdom of Tonga	Niuatoputapu	TONI59	-15.9308	-173.7800	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA33	-18.7570	-174.1228	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA34	-18.7244	-174.1064	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA35	-18.7328	-174.0845	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA36	-18.6574	-174.0700	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA37	-18.6610	-174.0677	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA38	-18.6380	-174.0675	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA39	-18.6470	-174.0670	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA40	-18.7308	-174.0098	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA41	-18.6688	-174.1035	September 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA42	-18.6909	-174.0289	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA43	-18.6883	-174.0699	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA44	-18.7434	-174.1119	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA45	-18.7966	-174.1095	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA46	-18.7192	-174.1512	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA47	-18.7989	-174.0451	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA48	-18.5830	-174.0057	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA49	-18.6162	-174.0286	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA50	-18.7386	-174.0424	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA51	-18.7634	-174.0206	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA52	-18.7740	-174.0054	September 2013
Pacific Ocean	Kingdom of Tonga	Vava'u	TOVA53	-18.7705	-174.0207	September 2013
Pacific Ocean	Lau Province, Fiji	Cicia	FJCC44	-17.7167	-179.3243	June 2013
Pacific Ocean	Lau Province, Fiji	Cicia	FJCC45	-17.7238	-179.3386	June 2013
Pacific Ocean	Lau Province, Fiji	Cicia	FJCC46	-17.7265	-179.3408	June 2013
Pacific Ocean	Lau Province, Fiji	Cicia	FJCC47	-17.7671	-179.3491	June 2013
Pacific Ocean	Lau Province, Fiji	Cicia	FJCC48	-17.7520	-179.3490	June 2013
Pacific Ocean	Lau Province, Fiji	Fulaga	FJFU24	-19.1240	-178.5480	June 2013
Pacific Ocean	Lau Province, Fiji	Fulaga	FJFU25	-19.0940	-178.5809	June 2013
Pacific Ocean	Lau Province, Fiji	Fulaga	FJFU26	-19.1011	-178.6011	June 2013
Pacific Ocean	Lau Province, Fiji	Fulaga	FJFU27	-19.1299	-178.6174	June 2013
Pacific Ocean	Lau Province, Fiji	Fulaga	FJFU28	-19.1411	-178.5706	June 2013

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Lau Province, Fiji	Kabara	FJKA30	-18.9414	-178.9847	June 2013
Pacific Ocean	Lau Province, Fiji	Kabara	FJKA31	-18.9194	-178.9577	June 2013
Pacific Ocean	Lau Province, Fiji	Kabara	FJKA33	-18.9545	-178.9874	June 2013
Pacific Ocean	Lau Province, Fiji	Kabara	FJKA34	-18.9228	-178.9363	June 2013
Pacific Ocean	Lau Province, Fiji	Mago	FJMG49	-17.4785	-179.1672	June 2013
Pacific Ocean	Lau Province, Fiji	Mago	FJMG50	-17.4639	-179.1877	June 2013
Pacific Ocean	Lau Province, Fiji	Mago	FJMG51	-17.4249	-179.1655	June 2013
Pacific Ocean	Lau Province, Fiji	Matuka	FJMT10	-19.1178	179.7382	June 2013
Pacific Ocean	Lau Province, Fiji	Matuka	FJMT11	-19.1585	179.7304	June 2013
Pacific Ocean	Lau Province, Fiji	Matuka	FJMT12	-19.1534	179.7401	June 2013
Pacific Ocean	Lau Province, Fiji	Matuka	FJMT13	-19.1172	179.7783	June 2013
Pacific Ocean	Lau Province, Fiji	Matuka	FJMT14	-19.1290	179.7866	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML15	-18.5919	179.9731	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML16	-18.5204	179.9656	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML17	-18.5325	179.9200	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML18	-18.5461	179.9013	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML19	-18.5794	179.8201	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML20	-18.5577	179.8785	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML21	-18.5972	179.9337	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML22	-18.6168	179.9389	June 2013
Pacific Ocean	Lau Province, Fiji	Moala	FJML23	-18.5575	179.9851	June 2013
Pacific Ocean	Lau Province, Fiji	Nayau	FJNA38	-17.9512	-179.0670	June 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Lau Province, Fiji	Nayau	FJNA39	-17.9759	-179.0767	June 2013
Pacific Ocean	Lau Province, Fiji	Nayau	FJNA40	-17.9651	-179.0789	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO01	-18.9960	-179.9032	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO02	-18.9728	-179.9068	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO03	-18.9273	-179.8907	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO04	-18.8886	-179.8677	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO05	-18.8981	-179.8836	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO06	-18.9976	-179.8473	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO07	-19.0032	-179.8485	June 2013
Pacific Ocean	Lau Province, Fiji	Totoya	FJTO08	-19.0230	-179.8808	June 2013
Pacific Ocean	Lau Province, Fiji	Tuvuca	FJTV41	-17.6498	-178.8354	June 2013
Pacific Ocean	Lau Province, Fiji	Tuvuca	FJTV42	-18.6909	-174.0289	June 2013
Pacific Ocean	Lau Province, Fiji	Tuvuca	FJTV43	-17.6935	-178.8325	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB52	-17.3028	-179.0309	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB53	-17.1394	-179.0600	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB54	-17.2376	-179.0386	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB55	-17.1534	-179.0049	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB56	-17.1395	-179.0599	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB57	-17.1715	-178.8871	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB58	-17.1960	-178.8707	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB60	-17.1206	-178.8265	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB61	-17.1518	-178.8512	June 2013

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB62	-17.2877	-178.9281	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB63	-17.2923	-178.8856	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB64	-17.3364	-178.8600	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB65	-17.3355	-178.8337	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB66	-17.3234	-178.8167	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB67	-17.2709	-178.7774	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB68	-17.1066	-178.6897	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB69	-17.0895	-178.7692	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Balavu	FJVB70	-17.1352	-178.7775	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Vatu	FJVV35	-18.3864	-179.2786	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Vatu	FJVV36	-18.3439	-179.2803	June 2013
Pacific Ocean	Lau Province, Fiji	Vanua Vatu	FJVV37	-18.3584	-179.2848	June 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR27	-18.9483	163.5726	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR28	-18.8709	163.5514	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR29	-18.8359	163.4847	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR30	-19.0986	163.5593	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR31	-18.9857	163.5055	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR32	-18.8845	163.4145	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR33	-19.0529	163.6825	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR34	-19.0606	163.6304	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR35	-18.8774	163.4398	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR36	-18.8493	163.5305	October 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	New Caledonia	Cook Reef	NCCR37	-18.8523	163.4477	October 2013
Pacific Ocean	New Caledonia	Cook Reef	NCCR38	-18.8539	163.4346	October 2013
Pacific Ocean	New Caledonia	Guilbert	NGU55	-17.9990	163.1097	October 2013
Pacific Ocean	New Caledonia	Guilbert	NGU56	-18.0148	163.1291	October 2013
Pacific Ocean	New Caledonia	Guilbert	NGU58	-18.0174	163.0889	October 2013
Pacific Ocean	New Caledonia	Guilbert	NGU59	-18.0578	163.0752	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU43	-17.8873	162.8975	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU44	-17.9362	162.8921	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU45	-17.9977	162.9063	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU46	-18.0613	162.8282	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU47	-17.9782	162.8960	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU48	-18.0360	162.9162	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU49	-18.2326	162.8883	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU50	-18.1956	162.8412	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU51	-18.1325	162.8159	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU52	-17.9198	162.9225	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU53	-17.9514	162.8922	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU54	-17.9691	162.9323	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU57	-17.9695	162.9171	October 2013
Pacific Ocean	New Caledonia	Huon	NCHU60	-18.0202	162.9656	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCNE10	-22.5694	167.1961	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI01	-22.6651	167.3512	October 2013

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	New Caledonia	Ile des Pins	NCPI02	-22.6522	167.3525	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI03	-22.6476	167.3696	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI04	-22.4963	167.3709	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI05	-22.5147	167.4135	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI06	-22.5763	167.3013	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI07	-22.6397	167.5641	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI08	-22.5994	167.5492	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI09	-22.7178	167.4490	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI13	-22.5812	167.3090	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI14	-22.7193	167.5872	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI15	-22.7006	167.3740	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI16	-22.7405	167.5422	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI17	-22.4588	167.3006	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI18	-22.4864	167.2364	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI19	-22.6398	167.3065	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI20	-22.5543	167.5330	October 2013
Pacific Ocean	New Caledonia	Ile des Pins	NCPI21	-22.5144	167.4423	October 2013
Pacific Ocean	New Caledonia	Merite	NCME64	-18.2002	163.0282	October 2013
Pacific Ocean	New Caledonia	Merite	NCME65	-18.2146	163.0172	October 2013
Pacific Ocean	New Caledonia	Pelotas	NCNE11	-22.5594	167.2079	October 2013
Pacific Ocean	New Caledonia	Pelotas	NCPE25	-18.5976	163.2353	October 2013
Pacific Ocean	New Caledonia	Pelotas	NCPE26	-18.5709	163.2119	October 2013

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	New Caledonia	Pelotas	NCPE75	-18.5390	163.2528	October 2013
Pacific Ocean	New Caledonia	Pelotas	NCPE76	-18.6014	163.1869	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO39	-18.5081	162.9084	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO40	-18.4582	162.8889	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO41	-18.4627	162.8376	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO42	-20.2633	163.8723	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO72	-18.4764	162.8420	October 2013
Pacific Ocean	New Caledonia	Portail	NCPO73	-18.5194	162.8704	October 2013
Pacific Ocean	New Caledonia	Prony Bay	NCPR22	-22.3139	166.8440	October 2013
Pacific Ocean	New Caledonia	Prony Bay	NCPR23	-22.3659	166.8905	October 2013
Pacific Ocean	New Caledonia	Prony Bay	NCPR24	-22.3520	166.8510	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU61	-18.5063	163.1277	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU62	-18.4967	163.2274	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU63	-18.4298	163.2314	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU66	-18.4647	163.0246	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU67	-18.3128	163.1197	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU68	-18.2784	163.0400	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU69	-18.2997	162.9874	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU70	-18.3959	162.9912	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU71	-18.4972	163.1004	October 2013
Pacific Ocean	New Caledonia	Surprise	NCSU74	-18.4632	163.0799	October 2013
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116153	-13.5010	144.0700	September-October 2014

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116154	-13.5176	144.0656	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116155	-13.5044	144.0823	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116156	-13.5382	144.0760	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116157	-13.5457	144.1068	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU116158	-13.5599	144.0805	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU122135	-11.2006	144.0388	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU122136	-11.2036	144.0570	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU122137	-11.1897	144.0472	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU122138	-11.1994	144.0530	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU238141	-11.9191	143.8412	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU238142	-11.9221	143.8590	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU238144	-11.9274	143.8487	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2577	-11.0519	143.0694	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2578	-11.0487	143.0817	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2591	-11.0861	143.1077	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2592	-11.0596	143.1140	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2593	-11.0660	143.0690	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU2594	-11.0929	143.0923	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3973	-11.2464	143.2569	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3974	-11.2477	143.2627	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3975	-11.2390	143.2490	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3976	-11.2364	143.2494	September-October 2014

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3995	-11.2430	143.2520	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU3996	-11.2401	143.2625	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4331	-15.4057	145.5040	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4332	-15.4236	145.5459	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4333	-15.4050	145.4933	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4334	-15.4447	145.5309	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4335	-15.4364	145.4773	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU4336	-15.4541	145.5005	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU5R139	-11.8605	143.8412	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU5R140	-11.8655	143.8498	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU5R143	-11.9091	143.8470	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU5R145	-11.9038	143.8259	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AU5R146	-11.8783	143.8323	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK43	-14.4440	145.4994	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK44	-14.4757	145.5019	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK45	-14.4548	145.4680	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK46	-14.4292	145.4502	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK47	-14.4580	145.5100	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUHK48	-14.4435	145.4562	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUJW55	-14.4056	145.3892	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUJW56	-14.3714	145.3846	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUJW57	-14.4195	145.3643	September-October 2014

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUJW58	-14.3935	145.4051	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUPK59	-14.4350	145.3450	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUPK60	-14.4318	145.3499	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR513	-15.3836	145.7739	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR514	-15.3910	145.7817	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR515	-15.3492	145.7789	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR516	-15.3304	145.7788	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR517	-15.3622	145.7911	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Blue Zone	AUR518	-15.3750	145.7940	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3479	-11.1548	143.0872	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3480	-11.1695	143.1137	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3481	-11.1862	143.0960	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3482	-11.1609	143.1016	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3483	-11.1720	143.0830	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU3484	-11.1947	143.1204	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74147	-13.4976	144.0491	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74148	-13.4570	144.0568	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74149	-13.4824	144.0321	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74150	-13.4739	144.0349	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74151	-13.4982	144.0507	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU74152	-13.4989	144.0600	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU96117	-11.4296	143.9669	September-October 2014

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU96119	-11.4212	143.9708	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU96120	-11.4308	143.9705	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU96121	-11.4214	143.9701	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AU96122	-11.4236	143.9824	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUEY163	-14.6870	145.3910	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUEY164	-14.6852	145.3821	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK19	-15.2760	145.6484	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK20	-15.2672	145.5805	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK21	-15.3040	145.6046	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK22	-15.2921	145.6253	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK29	-15.2745	145.5243	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AULK30	-15.3100	145.5800	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO100	-11.4740	143.1741	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO101	-11.4565	143.1428	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO102	-11.4796	143.1512	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO97	-11.4643	143.1607	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO98	-11.4867	143.1702	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUMO99	-11.4681	143.1427	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR701	-15.2073	145.7542	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR702	-15.2238	145.7512	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR703	-15.2077	145.7543	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR704	-15.1930	145.7331	September-October 2014

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR705	-15.2022	145.7531	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUR706	-15.2221	145.7391	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD129	-11.5210	143.6524	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD130	-11.5208	143.6667	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD131	-11.5155	143.6577	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD132	-11.5220	143.6591	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD133	-11.5159	143.6478	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUSD134	-11.5143	143.6555	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUWD104	-11.8108	143.9824	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUWD106	-11.8134	143.9662	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUWO103	-11.8199	143.9829	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUWO105	-11.8157	143.9677	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG37	-14.6189	145.6184	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG38	-14.5837	145.6303	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG39	-14.5888	145.6162	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG40	-14.6045	145.6325	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG41	-14.6150	145.6350	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Green Zone	AUYG42	-14.6000	145.6230	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A61	-13.3893	143.9565	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A62	-13.4224	143.9888	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A63	-13.3844	143.9608	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A64	-13.4098	143.9930	September-October 2014

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A65	-13.3980	143.9674	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU61A66	-13.3945	143.9877	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91111	-11.4030	143.9556	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91112	-11.3986	143.9677	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91113	-11.3999	143.9617	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91114	-11.4006	143.9570	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91115	-11.4037	143.9703	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU91116	-11.4040	143.9650	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AU96118	143.9775	-11.4211	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT49	-14.5579	145.5849	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT50	-14.5696	145.6088	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT51	-14.5281	145.5691	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT52	-14.5461	145.6021	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT53	-14.5300	145.5870	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUCT54	-14.5425	145.5755	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI159	-14.4280	145.4295	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI160	-14.4410	145.3949	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI161	-14.4301	145.4030	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI162	-14.4585	145.3980	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI165	-14.4410	145.4264	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUHI166	-14.4641	145.4119	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM85	-11.1758	143.0355	September-October 2014

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM86	-11.1975	143.0387	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM87	-11.1658	143.0099	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM88	-11.1913	143.0481	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM89	-11.1770	143.0170	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUMM90	-11.1880	143.0266	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE123	-11.5620	143.7091	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE124	-11.5590	143.7189	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE125	-11.5716	143.7120	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE126	-11.5643	143.7275	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE127	-11.5596	143.7142	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPE128	-11.5729	143.7202	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS67	-11.4604	143.1227	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS670	-11.4588	143.1246	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS68	-11.4606	143.1266	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS69	-11.4691	143.1194	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS70	-11.4588	143.1246	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS71	-11.4710	143.1320	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUPS72	-11.4603	143.1154	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR607	-15.2677	145.7576	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR608	-15.2720	145.7600	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR609	-15.2928	145.7520	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR610	-15.2714	145.7597	September-October 2014

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR611	-15.2813	145.7423	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUR612	-15.2840	145.7600	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL23	-15.3480	145.5594	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL24	-15.3482	145.5934	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL25	-15.3793	145.5897	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL26	-15.3720	145.5570	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL27	-15.3466	145.5278	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUWL28	-15.3670	145.6200	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUYD107	-11.9396	143.9603	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUYD108	-11.9663	143.9947	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUYD109	-11.9509	143.9761	September-October 2014
Pacific Ocean	Northern Great Barrier Reef, Australia	Pink Zone	AUYD110	-11.9400	143.9989	September-October 2014
Pacific Ocean	Republic of Palau	Aimeliik	PA32	7.4967	134.3828	January-February 2015
Pacific Ocean	Republic of Palau	Aimeliik	PA34	7.4101	134.4500	January-February 2015
Pacific Ocean	Republic of Palau	Aimeliik	PA83	7.4828	134.4219	January-February 2015
Pacific Ocean	Republic of Palau	Angaur	PA24	6.9211	134.1231	January-February 2015
Pacific Ocean	Republic of Palau	Angaur	PA25	6.8979	134.1150	January-February 2015
Pacific Ocean	Republic of Palau	Angaur	PA26	6.9071	134.1542	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA54	8.1677	134.6079	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA55	8.1823	134.6136	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA56	8.1993	134.6074	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA57	8.0940	134.6924	January-February 2015

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Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Republic of Palau	Kayangel	PA58	8.0679	134.6816	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA59	8.0716	134.6870	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA66	8.1538	134.6099	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA67	8.1481	134.6346	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA68	8.1909	134.6116	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA79	8.0480	134.6827	January-February 2015
Pacific Ocean	Republic of Palau	Kayangel	PA80	8.0840	134.6879	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA01	7.3271	134.4949	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA02	7.3355	134.4221	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA03	7.3617	134.4249	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA04	7.2693	134.3528	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA05	7.2799	134.3954	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA06	7.2927	134.4153	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA07	7.2581	134.5238	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA08	7.2840	134.5632	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA09	7.3564	134.2954	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA10	7.3010	134.2364	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA11	7.2962	134.2580	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA12	7.2623	134.2460	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA13	7.3423	134.2592	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA14	7.2505	134.2391	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA15	7.2586	134.1856	January-February 2015

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Republic of Palau	Koror	PA16	7.2836	134.2448	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA17	7.2659	134.2456	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA20	7.1112	134.2398	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA21	7.1356	134.2204	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA22	7.1722	134.2204	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA23	7.1181	134.2707	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA27	7.4129	134.3370	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA28	7.4407	134.3509	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA85	7.3267	134.4950	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA86	7.3228	134.4995	January-February 2015
Pacific Ocean	Republic of Palau	Koror	PA87	7.3223	134.4911	January-February 2015
Pacific Ocean	Republic of Palau	Ngaraard	PA50	7.6674	134.5992	January-February 2015
Pacific Ocean	Republic of Palau	Ngaraard	PA74	7.6327	134.5951	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA37	7.6917	134.5583	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA39	8.0103	134.5405	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA40	7.8514	134.5070	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA41	7.7810	134.5594	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA42	7.7125	134.5644	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA44	7.6761	134.5506	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA45	7.7717	134.5653	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA46	7.7439	134.5705	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA48	7.7156	134.5841	January-February 2015

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DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Republic of Palau	Ngarchelong	PA53	7.6815	134.5835	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA60	7.8708	134.5042	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA61	7.8905	134.5871	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA62	7.9654	134.5774	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA63	7.9626	134.5023	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA64	7.9805	134.5091	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA65	7.9539	134.6266	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA69	7.7746	134.5882	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA70	7.8139	134.5305	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA71	7.8025	134.6044	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA76	7.8293	134.5202	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA77	7.7605	134.5683	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA78	7.8936	134.4925	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA81	7.8157	134.5712	January-February 2015
Pacific Ocean	Republic of Palau	Ngarchelong	PA82	7.7844	134.6214	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA30	7.5988	134.4801	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA33	7.6323	134.5213	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA36	7.6569	134.5459	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA38	7.6464	134.5360	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA43	7.6563	134.5653	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA47	7.6403	134.5473	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA49	7.6448	134.5815	January-February 2015

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Republic of Palau	Ngardmau	PA51	7.5986	134.5081	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA52	7.6254	134.5609	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA72	7.6572	134.5796	January-February 2015
Pacific Ocean	Republic of Palau	Ngardmau	PA73	7.6105	134.4962	January-February 2015
Pacific Ocean	Republic of Palau	Ngaremlengui	PA29	7.5478	134.4587	January-February 2015
Pacific Ocean	Republic of Palau	Ngaremlengui	PA31	7.5451	134.4879	January-February 2015
Pacific Ocean	Republic of Palau	Ngatpang	PA35	7.5315	134.4363	January-February 2015
Pacific Ocean	Republic of Palau	Ngatpang	PA84	7.5074	134.4454	January-February 2015
Pacific Ocean	Republic of Palau	Peleliu	PA18	7.0626	134.2489	January-February 2015
Pacific Ocean	Republic of Palau	Peleliu	PA19	7.0827	134.2625	January-February 2015
Pacific Ocean	Solomon Islands	Gizo	SOGZ04	-8.1602	156.8210	October-November 2014
Pacific Ocean	Solomon Islands	Gizo	SOGZ05	-8.1569	156.8961	October-November 2014
Pacific Ocean	Solomon Islands	Gizo	SOGZ06	-8.1272	156.8621	October-November 2014
Pacific Ocean	Solomon Islands	Gizo	SOGZ07	-8.0868	156.7701	October-November 2014
Pacific Ocean	Solomon Islands	Gizo	SOGZ08	-8.1006	156.7978	October-November 2014
Pacific Ocean	Solomon Islands	Gizo	SOGZ09	-8.1141	156.8862	October-November 2014
Pacific Ocean	Solomon Islands	Kerehikapa	SOKR10	-7.4963	158.0532	October-November 2014
Pacific Ocean	Solomon Islands	Kerehikapa	SOKR11	-7.4829	158.0466	October-November 2014
Pacific Ocean	Solomon Islands	Kerehikapa	SOKR12	-7.4483	158.0211	October-November 2014
Pacific Ocean	Solomon Islands	Malakobi	SOML16	-7.3042	158.0440	October-November 2014
Pacific Ocean	Solomon Islands	Malakobi	SOML17	-7.4064	158.1562	October-November 2014
Pacific Ocean	Solomon Islands	Malakobi	SOML18	-7.3645	158.1978	October-November 2014

APPENDIX 2 | DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Solomon Islands	Malakobi	SOML19	-7.3348	158.0199	October-November 2014
Pacific Ocean	Solomon Islands	Malakobi	SOML20	-7.3482	158.0541	October-November 2014
Pacific Ocean	Solomon Islands	Malakobi	SOML21	-7.3504	158.0761	October-November 2014
Pacific Ocean	Solomon Islands	Marovo	SOMO28	-8.4066	157.9170	October-November 2014
Pacific Ocean	Solomon Islands	Marovo	SOMO29	-8.4327	157.9820	October-November 2014
Pacific Ocean	Solomon Islands	Munda	SOMU01	-8.3853	157.2227	October-November 2014
Pacific Ocean	Solomon Islands	Munda	SOMU02	-8.3498	157.2117	October-November 2014
Pacific Ocean	Solomon Islands	Munda	SOMU03	-8.3513	157.2239	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN22	-8.7721	157.7869	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN23	-8.7354	157.8394	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN24	-8.8227	157.8087	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN25	-8.6753	157.8055	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN26	-8.7733	157.7663	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN27	-8.7472	158.0933	October-November 2014
Pacific Ocean	Solomon Islands	Nono	SONN30	-8.6435	157.7931	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI52	-10.2840	166.1470	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI53	-10.2940	166.2950	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI54	-10.2830	166.1270	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI55	-10.2638	166.3691	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI56	-10.2580	166.3330	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI57	-10.3150	166.3450	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI58	-10.1840	166.2270	October-November 2014

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Solomon Islands	Reef Islands	SORI59	-10.1970	166.1110	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI60	-10.2842	166.2708	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI61	-10.1937	166.1922	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI62	-10.2168	166.0722	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI63	-10.2856	166.2272	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI64	-10.1640	166.2482	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI65	-10.1519	166.1976	October-November 2014
Pacific Ocean	Solomon Islands	Reef Islands	SORI66	-10.2550	166.2501	October-November 2014
Pacific Ocean	Solomon Islands	Sikopo	SOSI13	-7.4614	157.9996	October-November 2014
Pacific Ocean	Solomon Islands	Sikopo	SOSI14	-7.4666	158.0013	October-November 2014
Pacific Ocean	Solomon Islands	Sikopo	SOSI15	-7.4301	157.9617	October-November 2014
Pacific Ocean	Solomon Islands	Tinakula	SOTI67	-10.3735	165.8133	October-November 2014
Pacific Ocean	Solomon Islands	Tinakula	SOTI68	-10.3966	165.7904	October-November 2014
Pacific Ocean	Solomon Islands	Tinakula	SOTI69	-10.3762	165.7941	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT32	-11.2818	166.4478	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT33	-11.2966	166.4656	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT34	-11.2645	166.4449	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT35	-11.1880	166.5327	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT36	-11.2097	166.4722	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT37	-11.2402	166.4523	October-November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT38	-11.2278	166.5986	October-November 2014

APPENDIX 2

DIVE SITES AND SITE DESCRIPTIONS

Ocean Basin	Location	Island	Site Name	Latitude	Longitude	Date Surveyed
Pacific Ocean	Solomon Islands	Utupua	SOUT39	-11.3309	166.5210	October- November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT40	-11.2900	166.5955	October- November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT41	-11.3038	166.4747	October- November 2014
Pacific Ocean	Solomon Islands	Utupua	SOUT42	-11.3061	166.4617	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA43	-11.5856	166.9534	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA44	-11.5777	166.9413	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA45	-11.5844	166.9124	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA46	-11.5730	167.0009	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA47	-11.5952	166.9456	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA48	-11.5641	166.8685	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA49	-11.6150	166.7848	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA50	-11.5850	166.8088	October- November 2014
Pacific Ocean	Solomon Islands	Vanikoro	SOVA51	-11.5629	166.8267	October- November 2014

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Andrew Bruckner	Former KSLOF Chief Scientist	x	x	x	x
Philip Renaud	Former KSLOF Executive Director	x	x	x	x
Samuel Purkis	University of Miami, Rosenstiel School of Marine and Atmospheric Science (RSMAS) & Current KSLOF Chief Scientist	x	x		
Bernhard Riegl	Nova Southeastern University, National Coral Reef Institute (NCRI)	x	x		
Gwilym Rowlands	KSLOF Fellow, Former KSLOF, NCRI	x			
Abdullah Alsuhaibany	Contractor	x			
Ahmed Al-Mansi	National Commission for Wildlife Conservation and Development (NCWCD)	x			
Alasdair Harris	Blue Ventures	x			
Alastair Kennel	Contractor	x			
Ameer Abdullah	International Union for Conservation of Nature (IUCN) Global Marine Programme	x			
Anas Sambas	Contractor	x			
Anelise Hagan	Former KSLOF Executive Director	x			
Anthony Roupael	IUCN Global Marine Program	x			
Ben Stobart	Contractor	x			
David Obura	IUCN Global Marine Program	x			
Frederique Kandel	Contractor	x			
Glen Page	SustainaMetrix	x			
Hatem Al-Yami	Saudi Wildlife Commission	x			

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Herbert Ripley	Contractor	x			
Hussein bin Hajji	King Saud University	x			
Jeff Parks	Contractor	x			
Khalid Al-Shaikh	Jubail Marine Wildlife Sanctuary	x			
Martin Callow	Contractor	x			
Nicholas Claxton	Contractor	x			
Omar Al-Kushaim	NCWCD	x			
Raymond Buckley	Washington State University	x			
Sarah Hamylton	KSLOF Fellow, Southampton University	x			
Amanda Williams	Former KSLOF, GIS Analyst		x	x	
Kenneth Marks	Atlantic and Gulf Rapid Reef Assessment (AGRRA)		x		x
Alexandra Dempsey	KSLOF Director of Science Management		x		x
Nick Cautin	KSLOF Dive Safety Officer		x		x
David Grenda	Florida Aquarium		x		x
Judy Lang	AGRRA		x		x
Jeremy Kerr	KSLOF Fellow, Nova Southeastern University, NCRI		x		
Sonia Bejarano	KSLOF Fellow, University of Queensland		x		
Alannah Vellacott	College of The Bahamas		x		
Alexander Henderson	University of the West Indies		x		

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Alexio Brown	Young Bahamian Marine Scientists		x		
Ancilleno Davis	The Nature Conservancy (TNC)		x		
Christian Clark	Contractor		x		
Indria Brown	The Bahamas Department of Marine Resources		x		
Lindy Knowles	Bahamas National Trust (BNT)		x		
Matti Kiupel	Michigan State University		x		
Tavares Thompson	Contractor		x		
Timothy Payne II	KSLOF Dive Safety Officer		x		
Brooke Gintert	University of Miami, RSMAS			x	
Chris Biggs	TNC			x	
Chris Slade	TNC			x	
Cita Chaderton	Contractor			x	
Clare Morall	St. George's University			x	
Daniel Green	TNC			x	
Emma Grigg	Ross University, School of Veterinary Medicine			x	
Graeme Browne	Ministry of Sustainable Development			x	
James Byrne	TNC			x	
Jason Phillip	Contractor			x	
Jeanne Brown	TNC			x	

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Jerry Mitchell	St. George's University			x	
Nick Dupre	National Trust			x	
Thierry Beths	Ross University, School of Veterinary Medicine			x	
Tony Hall	Ross University, School of Veterinary Medicine			x	
Brian Beck	Former KSLOF Coral Reef Ecologist				x
Andrew Ross	Seascape Caribbean				x
Anna Ebanks	Ministry of Agriculture and Fisheries Jamaica				x
Azra Blythe-Mallet	Veterinary Services Division (VSD)				x
Ernie Kovacs	Camera Crew				x
Jesse Williams	Contractor				x
Julian Smith	Blogger				x
Llewelyn Meggs	TNC Jamaica				x
Nathalie Zenny	TNC Jamaica				x
Oliver Squire	Ministry of Agriculture and Fisheries Jamaica				x
Rachel D'Silva	Contractor				x
Sean Green	National Environment and Planning Agency (NEPA)				x
Steve Schill	TNC				x
Edward Gonzalez	Former KSLOF Education Director				
Allan Bright	University of Miami/Cooperative Institute for Marine and Atmospheric Studies (CIMAS)				

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Aurora Alifano	Island Conservation				
Brittany Huntington	National Research Council Postdoc (hosted at Southeast Fisheries Science Center (SEFSC); National Oceanic and Atmospheric Administration (NOAA) diver)				
Dana Williams	University of Miami/Cooperative Institute for Marine and Atmospheric Studies (CIMAS)				
Dave McClellan	NOAA/National Marine Fisheries Service (NMFS)/SEFSC				
Greg Piniak	NOAA/National Ocean Service (NOS)/Beaufort				
Jack Javech	NOAA/NMFS/SEFSC				
Jean Wiener	Contractor				
Jennifer Schull	NOAA/NMFS/SEFSC				
Jeremiah Blondeau	University of Miami/CIMAS				
Mandy Karnauskas	NOAA/NMFS/SEFSC				
Margaret Miller	NOAA/NMFS/SEFSC				
Natalia Zurcher	University of Miami/CIMAS				
Mike Trimble	CREW Teacher/Corona del Sol High School				
Anastasios Stathakopoulos	Nova Southeastern University, NCRI				
Alfredo Abril	CORALINA				
Alfredo Archbold	CORALINA				
Andrea Pacheco	CORALINA				
Felipe Cabeza	Felipe Diving Shop				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Gloria Hinstroza	Universidad de los Andes, Bogotá				
Heins Bent	CORALINA				
Joyce Schulke	Reef Environmental Education Foundation (REEF)				
Luis Olarte	Armada Nacional de Colombia - Dirección General Marítima				
Mark Schrope	Blogger				
Michael Haley	Contractor				
Nacor Bolanos	CORALINA				
Omar Abril	Universidad Jorge Tadeo Lozano of Bogotá				
Trisha Forbes	Fishery Department- Gobernation of the Archipelago of San Andrés, Providence and Santa Catalina				
Derek Manzello	University of Miami/NOAA, Atlantic Oceanographic and Meteorological Laboratory (AOML)				
Joao Monteiro	KSLOF Fellow, University of the Azores				
Alison Barrat	Former KSLOF Director of Communications				
Iliana Baums	Pennsylvania State University				
Joshua Feingold	Nova Southeastern University Oceanographic Center				
Peter Glynn	University of Miami				
Tyler Smith	University of the Virgin Islands				
Viktor Brandtneris	University of Miami				
Anderson Mayfield	KSLOF Fellow/Taiwan National Museum of Marine Biology and Aquarium				
Badi Samaniego	KSLOF Fellow, University of the Philippines				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Renée Carlton	KSLOF Marine Ecologist and NOAA/AOML/ University of Miami				
Marine Couraudon-Reale	Contractor				
Katherine Hillyer	Victoria University, Wellington				
Ian Enochs	NOAA/University of Miami				
Agnes Benet	Consultancy PROGEM				
Alexa Elliot	Public Broadcasting Service (PBS) "Changing Seas"				
Andre Ung	Institut Louis Malarde				
Andrew Calhoun	NCRI				
Candice Jwaszko	CREW Teacher, Ecole Paul Kane High School				
Claire Dolphin	Nova Southeastern University, National Coral Reef Institute				
Claude Payri	French National Research Institute (IRD)				
Erwan Delriue-Trotin	Pierre and Marie Curie University/Centre for Island Research and Environmental Observatory (CRIOBE)				
Eva McClure	University of Queensland				
Eve Perrin	Le Meridien Bora Bora				
Gabriel Haumani	Direction Des Ressources Marines				
Gaëlle Quere	Leibniz Center for Tropical Marine Ecology				
George Roff	University of Queensland				
Gerard Mou-Tham	IRD				
Gilles Siu	CRIOBE				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Jeff Williams	Smithsonian				
Jenna Moore	Scripps Institution of Oceanography				
Jim Evans	CREW Teacher/School Without Walls				
John Butscher	IRD				
Joseph Campazzoni	Direction des Ressources Marines				
Laetitia Hedouin	French National Centre for Scientific Research (CNRS)				
Laureline Chabran-Poete	IRD				
Maggy Nugues	CRIOBE				
Marie Kospartov	Marie Kospartov Consulting				
Marine Couraudon-Reale	Contractor				
Megan Berkle	CREW Teacher, Linda Esperanza Marquez Senior High School				
Megan Cook	Rolex Scholar				
Melanie Roue	IRD				
Michele Westmorland	International League of Conservation Photographers (iLCP)				
Mireille Chinain	Institut Louis Malarde				
Pauline Boserelle	CRIOBE				
Peter Mumby	University of Queensland				
Pierre Sasal	CNRS				
Robert Steneck	University of Maine				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Sean Hickey	Public Broadcasting Service (PBS) "Changing Seas"				
Serge Andrefouet	IRD				
Serge Planes	CNRS				
Simon Van Wynsberge	Universite de Polynesia Francaise				
Sylvain Petek	IRD				
Jean-Claude Gaerter	IRD				
Bertrand Make	Direction des Ressource Naturelles (DIREN)				
Valetina Piveteau	Direction des Ressource Naturelles (DIREN)				
Scott Cutmore	University of Queensland				
Fabian Tertre	Direction des Ressources Marines				
John Ruthven	Film Crew		x		
Doug Allen	Film Crew		x		
Erwan Delrieu Trotin	Pierre and Marie Curie University (Paris 6)				
William Robbins	Wildlife Marine				
Yves-Marie Bozec	University of Queensland				
Joseph Campanozzi-Tarahu	Direction des Ressources Marines				
Gerad Moutham	IRD				
Jacqui Evans	Moana Foundation				
Katangi Kaukura	Cook Islands Ministry of Marine Resources				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Kate Fraser	University of Queensland, Independent Contractor				
Kevin Iro	Cook Islands Marine Park				
Malcolm Cromie	Film Crew				
Ngereteina George	Cook Islands Ministry of Marine Resources				
Richard Story	Cook Islands Ministry of Marine Resources				
Ted Nia	Cook Islands Ministry of Marine Resources				
Teina Rongo	Cook Islands Ministry of Marine Resources				
Tom Cribb	University of Queensland				
Tou Ariki	High Chief				
Michael Henry	Independent Contractor				
Dawn Bailey	DIVE IN				
Amy Heemsoth	KSLOF Director of Education				
Janet Eyre	REEF Check				
Josefa Cinavilakeba	Paramount Chief, Pacific Blue Foundation				
Laitia Ralao	Protocol Officer for the Lau Provincial Council's Office				
William Saladrúa	Fiji Ministry of Primary Industries- Fisheries Department				
Ron Vave	Wildlife Conservation Society (WCS)				
Stacy Jupiter	WCS				
Robert Gardiner	NCRI				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Fiona Webster	Kingdom of Tonga Ministry of Agriculture, Forestry and Fisheries				
Apai Moala	Kingdom of Tonga Ministry of Agriculture, Forestry and Fisheries				
Hoifua 'Aholahi	Kingdom of Tonga Ministry of Agriculture, Forestry and Fisheries				
Karen Stone	Vava'u Environmental Protection Association (VEPA)				
Malakai Finau	Kingdom of Tonga Ministry of Agriculture, Forestry and Fisheries				
Nate Formel	University of Miami				
Sione Tui'moala Mailau	Kingdom of Tonga Ministry of Agriculture, Forestry and Fisheries				
Steve Saul	Nova Southeastern University, National Coral Reef Institute				
Katie Lubarsky	University of Hawaii				
Kristen Stolberg	Contractor				
Stefan Andrews	Contractor				
Grace Frank	James Cook University				
Samantha Clements	Scripps Institution of Oceanography				
Shanee Stopnitzky	University of California, Santa Cruz				
Konrad Hughen	Woods Hole Oceanographic Institution				
Abigail Cannon	Scripps Institution of Oceanography				
Bar Avalon	Contractor				
Johnathan Barnes	KSLOF Dive Safety Officer				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
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APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Kirsty Nash	Contractor				
Valeriya Komyakova	Contractor				
Yogi Freund	iLCP				
Georgia Coward	Oceans Watch/Contractor				
Benjamin Neal	XL Catlin Seaview Survey				
Garret Johnson	University of Maine				
Harry Noel	Department of Fisheries Solomon Islands				
Ivory Akao	Department of Fisheries Solomon Islands				
Kristen Brown	XL Catlin Seaview Survey				
Peter Dalton	XL Catlin Seaview Survey				
Ulrike Siebeck	XL Catlin Seaview Survey				
Wade Fairle	Film Crew				
John Laulae	Solomon Islands Community Liason				
Chief John Still Niola	Solomon Islands Community Liason				
Honorable Earnest Fea	Solomon Islands Community Liason				
Justin King	KSLOF Dive Safety Officer				
Asap Bukurrou	Palau International Coral Reef Center (PICRC)				
Geraldine Rengiil	PICRC				
Graham Kolodziej	NOAA/AMOL/University of Miami				

APPENDIX 3 | PARTICIPANT LIST

Participant	Affiliation	Saudi Arabian Red Sea	Bahamas	St. Kitts and Nevis	Jamaica
Julie Hartup	PICRC				
Marine Gouezo	PICRC				
Steve Lindfield	PICRC				
Uli Olsudong	PICRC				
Keith Ellenbogen	iLCP				
Carly Reeves	Contractor				
Chris Mirbach	University of Queensland				
Colleen Hansel	Woods Hole Oceanographic Institution				
Gideon Butler	Scripps Institution of Oceanography				
Justin Ossolinkski	Woods Hole Oceanographic Institution				
Lauren Valentino	NOAA/AMOL/University of Miami				
Luis Ramirez	Nova Southeastern University, NCRI				

Navassa	Colombia	Galapagos	French Polynesia	Cook Islands	Lau Province, Fiji	Tonga	New Caledonia	Northern Great Barrier Reef	Solomon Islands	Palau	Chagos Archipelago
										x	
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											x
											x
											x

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