

UC San Diego

Capstone Papers

Title

Building Partnerships for Science Communication and Application in the Line Islands of Kiribati

Permalink

<https://escholarship.org/uc/item/3xn209dj>

Author

Maddalene, Taylor

Publication Date

2015-04-01



Building Partnerships for Science Communication and Application in the Line Islands of Kiribati

Taylor Maddalene

Capstone, Masters of Advanced Studies in Marine Biodiversity and Conservation

Center for Marine Biodiversity and Conservation
Scripps Institution of Oceanography
University of California, San Diego

June 11, 2015

Table of Contents

Acknowledgements	3
I. Executive Summary	4
II. Introduction	5
Overview of the Project	5
Background on Kiribati	5
Case Study: History and Causes of the Science Communication Gap	5
SIO Research in Kiribati	6
Justification and Momentum For Science Communication and Collaboration	7
III. Methods	8
Literature Review and Background Interviews	8
Site Visit to Tarawa	8
Follow-Up From the Site Visit	9
IV. Results and Discussion	10
Overview of Marine Management and Conservation in Kiribati	10
Managing Entities and Structure.....	10
Key Governing Documents.....	11
Management Gaps and Challenges.....	13
Upcoming Management Opportunities.....	14
Guidelines for Communication	15
Products Following the Site Visit	16
The Future of Collaboration Between SIO and Kiribati	17
V. Conclusion	18
VI. References	20
VII. Appendix	22
Table 1: Contacts Prior to Site Visit	22
Table 2: In-Person Interviews in Tarawa	23
Table 3: Contacts Made During Site Visit and through Follow-up Interactions	24
Figure 1: Education and Outreach Posters	25
Figure 2: Organizational Chart of the Kiribati Government as it relates to Environmental Management	28

Acknowledgements

I would like to acknowledge and thank all of those who supported me throughout this Capstone Project and during my year at Scripps Institution of Oceanography (SIO). I could not have done it without your continued support, insight, and patience. I would especially like to thank the following:

My Capstone Committee: Stuart Sandin with SIO (Chair), Jennifer Smith with SIO, and Randi Rotjan with New England Aquarium.

Partners at the New England Aquarium: Regen Jamieson and Randi Rotjan.

Partners at Conservation International: Schannel van Dijken and Sue Taei.

Fabulous supporters at SIO and beyond: Phaedra Doukakis with CMBC, Dick Norris with CMBC, Forest Rohwer with SDSU, Jane Weinzierl with CMBC, Brian Zgliczynski with SIO, the Sandin and Smith Labs at SIO, and so many others!

Key partners in Kiribati: Ratita Bebe with ECD, Bibiana Bureimoa with the Ministry of Education, Taati Eria with the Fisheries Division, Tenikoiti Kaitu with ECD, Marii Marae with ECD, Baraniko Namanoku with the Ministry of Education, Betarim Rimon with PIPA, Reeti Onorio Rui with the Tourism Office, Robite Teaete with ECD, Tukabu Teroroko with PIPA, and many, many others!

For a full list of partners and contributors, please see the Appendix.

Thank you!

I. Executive Summary

The aim of this project was to start a relationship and initiate dialogue between Scripps Institution of Oceanography (SIO) and those responsible for management in Kiribati. Scripps has been conducting research in the waters of Kiribati for over a decade, and yet the timing and personnel has never aligned to allow for SIO staff to make contact and have face-to-face discussions with the management agencies in Kiribati. I set out to initiate that contact and to learn what I could about the management system there, and to foster partnerships so that SIO science may help build capacity for effective management in Kiribati.

As one of the foremost oceanographic research institutes in the world, SIO is widely renowned for its sound science and innovative approaches to research across the globe. With that credibility and global perspective comes a unique opportunity for that science to become relevant, and to be directly applied to management and conservation decisions that are made for marine ecosystems around the world. This is a niche that is not yet filled in many academic and research institutions, and SIO may be an ideal launching pad for this type of solution-based science. For my Capstone, I dedicated my year to initiating contact with key management and conservation partners in Kiribati and testing the viability of a partnership whereby SIO plays a scientific advisory role to support their management initiatives.

This project became largely an exercise in listening. A great deal of time and effort goes into building relationships and trust for these types of partnerships, and it is crucial to take the time to listen to what the local partners' priorities are, what their capacity is, and what vision they have for their organization and for the country in general before you can initiate discussions about if and how science can play a supporting role in those decisions. I went into this endeavor not knowing what to expect, and found it to be tremendously rewarding. The importance of face-to-face meetings and the value of listening cannot be overstressed when building partnerships and capacity for marine management and conservation. Not only were the partners that I met with extremely receptive to our meetings and discussions, but they had their own ideas about how SIO could work in concert with their initiatives and were extremely excited to discuss potential collaborations. The product of this Capstone was three-fold: creating those personal relationships and building trust with key organizations in Kiribati and with their partners, developing a user-guide for SIO's continued engagement with Kiribati, and conceptualizing the future of these types of scientific-application partnerships for SIO.

One of the most exciting parts of this project is the potential for extrapolation. SIO conducts research in every ocean basin of the world, and the possibilities are endless for SIO's ability to liaise directly with those responsible for management in different locations and to ensure that the science is available, useful, and supportive for their initiatives. This partnership that has been initiated in Kiribati is a valuable starting point and proof-of-concept for this type of work. Depending on future resources, SIO may have the unique opportunity to create a position or a team of individuals that is dedicated to liaising with management and conservation entities across the globe. This person or team would be responsible for ensuring that SIO research is available in an appropriate format so that it may be directly applied to inform decisions and tackle the unprecedented coupled human-natural issues that all nations are currently facing.

II. Introduction

Overview of the Project

The challenge of determining how scientific research can effectively inform environmental management decisions is universal. There is often a communication gap between scientific and academic institutions and the agencies responsible for conservation and management in the countries where research is being conducted. Scripps Institution of Oceanography (SIO) possesses possibly the most comprehensive collection of information on the natural environment of Kiribati, particularly the Line Islands, than any other institution in the world. SIO therefore has an opportunity to work with local management and conservation partners to ensure that science is available, useful, and supportive of the country's marine protection priorities. The goal of this project was to initiate contact between SIO and those responsible for marine conservation and management in Kiribati and begin a two-way dialogue to ensure that past, present, and future SIO research informs conservation and management decisions in Kiribati, particularly with respect to the Line Islands. This document is intended to be a user-guide to inform collaboration between SIO and the managing entities of Kiribati and their partners, a baseline and living document that could be regularly updated to ensure effective communication and relationships are maintained, and a model for developing and replicating these types of applied science partnerships around the world.

Background on Kiribati

The Republic of Kiribati is in the heart of the South Pacific and consists of 33 coral atolls that span across 3.5 million km² of ocean. The nation is separated into three major groups of islands: the Gilbert Islands, the Line Islands, and the Phoenix Islands. The total population of Kiribati is roughly 100,000 and growing, and over 50% of that population resides on the capital of Tarawa in the Gilbert Island group (Campbell and Hanich, 2014). The nature of fishing in Kiribati spans from large-scale commercial fishing by foreign vessels, the license fees from which constitute over 70% of country's GDP, to small-scale subsistence and artisanal fisheries, to aquaculture for international export. The country is facing unprecedented challenges with respect to the changing nature of the fishing industry, pressure associated with globalization, climate change and sea level rise, and overpopulation (Campbell and Hanich, 2014). The Government of Kiribati is exploring avenues to promote and protect their natural resources, and to leverage that in such a way that supports the socio-economic needs of the country.

Case Study: History and Causes of the Science Communication Gap

We as a global society are facing challenges related to our coupled human-natural systems that cannot be solved by one single discipline such as science, economics, humanities, or policy. Instead, these sectors need to communicate and work together to provide innovative solutions. This is easier said than done. The flow of knowledge between these groups is hampered by a variety of factors such as "language" barriers (in the technical sense), ownership of information, misunderstandings and misconceptions of skill and responsibility, perceived infringement on territories and jurisdiction, and cultural differences (Roux et al., 2006). The line of communication from scientists to managers, policy-makers, and the public is not devoid of these kinks. Scientists must ensure that their research is salient and credible, decision-makers must

balance the need for scientific evidence with the need to act in the face of uncertainty, and managers are largely responsible for managing the human interaction with the natural environment in a way that takes into account the science as well as the policy (Cook et al., 2013).

Scientific research has a long history of disciplinary fragmentation, particularly between knowledge generation and application (Roux et al., 2006). One literature review from 2013 noted that of 464 peer-reviewed articles on artisanal coral reef fisheries, only 22% presented management recommendations based specifically on the research in the articles (Johnson et al., 2013). Applied ecology – research that “focuses on the application of ecological concepts, theories, models and methods to address current real-world problems, with the ultimate aim to develop improved management practices (Andreassen, 2013)” – is a fairly new area of science that has become increasingly popular over the last 50 years as concerns over environmental issues have mounted. The Journal in Applied Ecology released its first issue in 1964, though management topics had previously been discussed in other scientific journals (Andreassen, 2013). Though it may not be considered its own separate discipline in the scientific world, the principles and intentions surrounding the idea of applied ecology are beginning to spread throughout the scientific community.

There is no doubt that informal science communication has skyrocketed in recent years, particularly with the use of social media and science blogs. But these are often done by third party organizations or spokesmen. The communication line directly between scientific and academic institutions and those responsible for conservation and management is still often blurred. Some attribute the lack of hard science communication to the fact that scientific research is often seen as disposable and constantly-changing commodity rather than something that can be built upon and adapted to over time (Bonasio, 2015). However, many institutions, such as Scripps Institution of Oceanography, are now developing large-scale research initiatives such as the 100 Island Challenge that present a unique opportunity for baseline development and real-time comparisons between locations and between time series. This type of comprehensive work is extremely valuable for application in policy development and management. A paradigm shift is therefore required to ensure that the lines of communication are opened and maintained between those conducting science and those that are able to apply that science to directly inform management and conservation.

SIO Research in Kiribati

The Sandin and Smith labs at SIO have had the opportunity to grow knowledge of coral reefs from around the world, and as such they have a very unique perspective on the processes that govern reef function. To date, the Sandin and Smith labs at SIO have conducted six research cruises and four land-based expeditions to the Line Islands and this fall they will complete their third research cruise to the Phoenix Islands. The Line Islands offer a unique opportunity for scientists to study environmental factors along a gradient of human impact, and research areas have spanned the whole gamut of coral reef ecology from microbiology to benthic surveys to fish biology and community structure. The near-pristine coral reef environments of the Phoenix Islands and Line Islands offer a “natural laboratory” where areas of extremely high coral cover and fish biomass allow scientists to study coral reef resilience in an era of anthropogenic change (Rotjan et al., 2014). Many publications have come from this research, and one such paper titled *Baselines and Degradation of Coral Reefs in the Northern Line Islands* (Sandin et al., 2008) has been cited over two hundred fifty times.

SIO research from the Line Islands has led to scientific conclusions and findings that have revolutionized how we study and understand coral reef processes. These discoveries include the mechanisms behind “black reefs” and the biological implications of shipwrecks (Wegley et al., 2012), the nature of coral-algae competition on coral reefs across levels of human impact (Barott et al., 2012; Smith et al., 2006), microbial dynamics and community structure in a near-pristine coral reef ecosystem (Barott et al., 2010; Dinsdale et al., 2008; Friedlander et al., 2010), differences in fish assemblages across gradients of fishing pressure (DeMartini et al., 2008), and many others.

Many of these scientific studies have also yielded management implications. For example, research from the Line Islands on the effects of nutrients and fishing suggest that reducing the fishing pressure on herbivores may have a more significant impact on the protection of reefs than concentrating management effort on reducing nutrient pollution (Walsh, 2011). Other studies suggest previously unexplored implications of fishing and predator-induced effects on community structures of coral reefs that should be considered in ecosystem-based management initiatives (Ruttenberg et al., 2011). Perhaps most critically, scientific research in Kiribati by SIO and others has provided a baseline representation of some of the most pristine coral reefs in existence on which to compare degradation, resilience, and the status of other reefs around the world (Sandin et al., 2008).

Justification and Momentum For Science Communication and Collaboration

The Republic of Kiribati is in the early stages of building capacity for effective large-scale conservation, with the recent designation of their Phoenix Islands Protected Area (PIPA) in 2008 - the second largest marine protected area (MPA) in the world and the largest and deepest UNESCO World Heritage Site - and growing momentum and commitment from the government to secure similar protection for the territorial waters surrounding the Line Islands. The management agencies in Kiribati are currently building capacity for scientific research, effective regulations, supportive environmental policies, management planning, marine protected area (MPA) implementation, and enforcement to protect their coral reefs. At a UN Small Island Developing States (SIDS) meeting in September 2014, President Tong of Kiribati declared, “we cannot do this alone,” and stated that the future of Kiribati will lie in strategic partnerships that tackle issues related to their coupled human-natural system. Kiribati is poised to be a leader among Pacific Small Island Developing States to create an effective dialogue between scientists and managers to make informed decisions that support the long-term stability of their people, natural resources, and economy.

The reason that increasing the application of SIO science for Kiribati management discussions has not been addressed in the past is that scenarios, interest, and capacity have not yet aligned to support this type of endeavor – until now. The Sandin and Smith labs at SIO have wanted to become more involved in science communication and informed policy in Kiribati for several years, since the first research cruise to the Line Islands in 2005. Likewise, stakeholders and partners involved in Kiribati have expressed interest in SIO researchers having a stronger presence in management discussions. However, timing and personnel availability have never aligned to allow for the required trips and in-person discussions. In March 2015, I traveled to Tarawa with SIO post-doc Brian Zgliczynski to meet with local managers and learn about their initiatives and priorities, which started the conversation of potential collaborations. The goal was to gain a better understanding of the management system in Kiribati so that SIO scientists know

who to contact and what type of science and materials would be valuable, and also to make initial in-person contact with key people and agencies so that the lines of communication are open as SIO continues to conduct research in Kiribati. There now exists growing momentum and impetus for these conversations to translate to action and for these partnerships to grow.

III. Methods

Literature Review and Background Interviews

This project started with a large amount of background research on the natural history of Kiribati, the development of PIPA, SIO research in the Line Islands, the structure of the parliament and management agencies in Kiribati, and the nature of the engagement of other partners such as Conservation International (CI), the New England Aquarium, and the National Oceanic and Atmospheric Administration (NOAA). Over 20 semi-structured interviews and informal meetings were held with professionals that have been engaged in conservation in Kiribati or in similar initiatives across the Pacific (see Table 1 in Appendix for full contact list). Over 50 scientific papers, management plans, communication plans, development plans, government publications, partnership documents (ex. memorandums of understanding), economic analyses, and news articles were reviewed to better understand the past and current state of marine science, conservation, and management in Kiribati.

Site Visit to Tarawa

In order to initiate face-to-face discussions with partners in Kiribati regarding conservation, I traveled to the capital of Tarawa for one week in March 2015 with Brian Zgliczynski. This was the first time that SIO staff had visited the capital to meet with the local management agencies, as research is mostly conducted in the outer islands. Meetings were held with eight staff members from five different management agencies in Kiribati (see Table 2 in Appendix for full interview list). The semi-structured interviews were largely an exercise in listening for Brian and myself. The goal was to gain a better understanding of the initiatives and priorities of marine management in Kiribati. The interviews typically started with the Kiribati staff discussing their positions, responsibilities, capacity, priorities, governing documents and policies, current initiatives, and visions for the future. Brian and I then discussed some of the work that SIO has conducted in Kiribati over the last decade and showed some of the products that have come from that work, such as the coral reef photomosaics, underwater photographs from the research cruises, postcards with the www.coralreefsystems.com website, and Forest Rohwer's book *Coral Reefs in the Microbial Seas*. The conversations ended with Brian and I expressing our gratitude for the visit, and our desire for continued two-way communication between SIO and the management entities in Kiribati as SIO continues to conduct research expeditions to Kiribati, and as Kiribati continues to develop its marine protection and conservation initiatives.

The initial goals (and typical topics of discussion covered/guiding questions asked during the semi-structured interviews) for the site visit were as follows:

- 1) **Managing Entities and Structure:** Understand the management system in Kiribati, including key agencies and staff, structure of the system, priorities, initiatives, values, hopes for the future, etc.

- 2) Gaps and Challenges: Learn about what has and has not worked with the planning, development, implementation, and enforcement of marine conservation initiatives (such as PIPA).
- 3) Upcoming Management Opportunities: Gain information on the perception of the marine environment, key current and upcoming management actions, and desires for conservation and management of the Line Islands specifically.
- 4) Guidelines for Communication: Discuss with staff in Kiribati if/how SIO can help inform their work, such as what information or materials would be valuable, what would be the best way for them to receive the information, are there areas that make sense for collaboration, how can we open the lines of communication in the future?
- 5) Future Collaboration: Understand what the staff in Kiribati would like to learn from SIO researchers as they continue to conduct research in Kiribati, and what they would like to hear from SIO when they come to Kiribati for workshops and meetings, such as NOAA Capacity Building Workshops, PIPA Scientific Advisory Meetings, PIPA Trust Meetings, and others that may arise.

The site visit was overall successful. We gained the information that we wanted based on our original goals and we met with the key representative agencies. I had originally hoped to meet with a larger number of people (see Table 3 in Appendix), but there were some challenges with the interview process, both planned and unforeseen. For example, Tarawa was impacted by Tropical Cyclone Pam during our time there, which meant that getting around was difficult due to flooding and structural damage, commutes were much longer due to the poor quality of the roads, and government staff were not necessarily working from their offices. Also, due to cultural norms in Kiribati, meetings were not planned on a rigid schedule as they would be in the US – for example, instead of deciding on a date, time, and location, the plan for the interviews was much more along the lines of calling the office or showing up at the office and seeing which staff were available to meet. I was alerted to this prior to the trip and was fully aware that this would be the case. Some government staff on Kiribati also have limited Internet access, which made contact prior to the site visit challenging.

Follow-Up From the Site Visit

Following the site visit, I continued corresponding with the staff members that we met. In particular, regular contact was made with Ratita Bebe with the Environment and Conservation Division, and also with Tukabu Teroroko and Betarim Rimon with the PIPA Office. There were several follow-up products that were discussed during the semi-structured interviews that would strengthen the relationship between SIO and the management agencies of Kiribati and would also be a sign-of-good-faith that SIO would like to help support and contribute to conservation decisions that are made there. For example, there were several other scientific studies and institutions that the management agencies were aware of that had been conducted in Kiribati, but from which they hadn't seen the final products or received an update on progress – staff in Kiribati therefore asked if SIO could put them in contact with those scientists. Kiribati staff also requested SIO cruise reports and other research that has come out of the expeditions to Kiribati. We also heard from staff in Kiribati that education and outreach posters would be a helpful tool for communicating and applying SIO research, which are covered more in Section IV below. Communication was maintained with partners from CI and the New England Aquarium on future development of this partnership between SIO and the management entities in Kiribati. Based on

this experience and this body of work, the Sandin and Smith labs at SIO are currently conceptualizing what the future of this partnership, and potentially similar partnerships in other parts of the world where SIO is conducting research, may look like and grow into.

IV. Results and Discussion

Overview of Marine Management and Conservation in Kiribati

One of the main goals of the trip to Tarawa was to understand how the marine conservation and management system in Kiribati operates. From there, we were able to discuss with staff in Kiribati if and how scientific research from SIO can help inform their decisions moving forward.

Managing Entities and Structure

In terms of a management “roadmap” for Kiribati, I have learned a great deal about how the management agencies are structured, what their priorities are, and how decisions are made. All of the agencies’ main offices are located in Tarawa, though there is one remote office on Kiritimati Island that houses several Environment and Conservation Division (ECD) and Fisheries Division staff, as well as one office that is currently being built on Kanton for PIPA staff. The outer islands are represented in conservation and management decisions by Island Councils. Kiribati became independent from the United Kingdom in 1979 and it still retains much of the British government cabinet structure. The Kiribati Parliament consists of the President, the Vice President, the Attorney General, and 12 Ministries below them:

- Ministry of Commerce and Industry Cooperative
- Ministry of Communications, Transport, and Tourism Development (MCTTD)
- Ministry of Education
- Ministry of Environment, Lands and Agriculture Development (MELAD)
- Ministry of Finance and Economic Development
- Ministry of Fisheries and Marine Resources Development (MFMRD)
- Ministry of Health and Medical Services
- Ministry of Internal and Social Affairs
- Ministry of Labour and Human Resource Development
- Ministry of Lines and Phoenix Islands Development (MLPID)
- Ministry of Public Works and Utility
- Ministry of Women, Youth and Sports

For a full organizational chart of the government entities in Kiribati that are responsible for or relate to environmental management, please see Figure 2 in the Appendix.

In terms of jurisdiction, the MFMRD is the main agency responsible for fisheries management in Kiribati. Most of their branches and resources are focused on offshore fishing of pelagic species by international fleets. The Fisheries Division within MFMRD houses about 90 staff total – 50 based in Tarawa – and deals with coastal fisheries, outer islands, and aquaculture to some extent. For example, they are in the process of developing Fishing Regulations and they currently run several aquaculture initiatives, mainly for seaweed, milkfish, and giant clams. Supporting the Fishing Regulations, the Fisheries Division is still trying to determine what the most effective forms of enforcement will be (ex. point fines). They have more of a capacity for conducting

marine research than the other managing agencies in Kiribati, though their focus is more on the fisheries rather than the marine environment itself.

MELAD handles environmental management beyond fisheries. The Environment and Conservation Division (ECD) within MELAD focuses on coastal restoration (ex. mangrove planting), terrestrial conservation (wildlife sanctuaries, such as the one on Maudlin), environmental education and outreach (such as school visits and hands-on restoration activities), and has some responsibility for marine species (ex. protected species [whales and turtles], MPA development on Kiritimati, installing moorings, Community Based Conservation Areas in Tarawa, etc.). ECD is also heavily involved in biosecurity and receives funding from external agencies (such as AID organizations) for eradication of invasive species – mostly rats and other rodents on the outer islands where there are seabird sanctuaries. For more information on the priorities of ECD, please see Kiribati’s Integrated Environmental Policy 2015, or visit their website: <http://www.environment.gov.ki/>. The PIPA Office is also housed within MELAD, though they are essentially a separate entity and have their own funding mechanism – the PIPA Trust. PIPA was co-created by The Government of Kiribati, Conservation International, and the New England Aquarium. Over time, responsibility has been largely handed over to the 5 Kiribati staff based in Tarawa. For more information on PIPA and their office, please visit their website: <http://www.phoenixislands.org/index.php>.

MCTTD focuses most of its funding and resources on communication and transportation rather than tourism. Tourism is concentrated largely on the outer islands. However, they are hoping to do more promotion of eco-tourism in the future, particularly as their near-pristine coral reefs are getting growing international attention. They are also still trying to figure out the best ways to market PIPA and any other protected areas they may create, but are hoping to use those as a tool to promote Kiribati in the coming years.

I also spoke with the Ministry of Education’s Curriculum Development and Assessment Division, which is another avenue by which SIO may be able to contribute science to conservation in Kiribati. They are hoping to develop a curriculum that is more targeted at their own marine environment and they are specifically hoping to incorporate PIPA concepts, particularly in the draft Y3-4 and Y5-6 curriculum. In May 2015 there was a National Education Summit and also a Curriculum Workshop held in Tarawa, at which the PIPA Office and ECD both had strong presence in discussions. Betarim Rimon from the PIPA Office offered to send the reports from those workshops to SIO for reference once they are complete.

There are definitely two very separate issues in play in Kiribati, with very distinct managing agency responsibility and funding delegation – community sustainability and marine resource protection. SIO has research to support the latter. The two are not yet effectively married, and perhaps shouldn’t be, though there may be opportunity in the future for resource protection to begin feeding benefits back to support social issues. There is also a distinct difference between the coastal fisheries (largely subsistence) and pelagic fisheries (largely by international fleets – which is the resource and funding powerhouse). These distinctions should be kept in mind when engaging in management discussions and when conceptualizing future conservation action.

Key Governing Documents

The following documents are several of the current governing documents for marine conservation and management in Kiribati that are applicable to coastal marine environments and

coral reefs. These should be referred to when liaising with management agencies on research and should be regularly checked for updated versions:

- Kiribati Development Plan (KDP) 2015
 - The KDP is put together by a wide range of stakeholders across Kiribati at a collaborative Summit. The document identifies several Key Policy Areas and proposes a series of actions, outcomes, and associated responsibility for the government to address each one. Each version also reviews progress towards these goals since the previous one. This document is updated every four years.
- Kiribati's Integrated Environmental Policy (KIEP) 2015
 - This is the sector-specific version of the KDP that relates to the country's principles and strategic plan for the environment. The environment was deemed a KPA in the KDP of 2008, and as such MELAD took the opportunity to create the KIEP in an effort to more formally incorporate environmental issues into the national development agenda. It is updated by the ECD within MELAD in concert with the KDP every four years.
- National Biodiversity Strategy and Action Plan (NBSAP) 2007-2011
 - Under the mandate of the United Nations Environmental Programme (UNEP), Kiribati has been working on implementing a NBSAP for Kiribati. It provides an assessment of terrestrial and marine biodiversity, with input from Participatory and Learning Actions (PLA) workshops, community consultations and biodiversity surveys. It also includes NBSAP goals, objectives, development strategies, and action plans. The current version is due to be updated.
- Convention on Biological Diversity (CBD)
 - The CBD is overseen by UNEP, and MELAD is the National Focal Point for the document in Kiribati. The 5th National CBD was released by ECD and the Wildlife Conservation Unit, with input from Kiribati's National Biodiversity Steering Committee, within MELAD in 2014, and is released by them every several years. It provides regular updates on the status, trends, threats, and implications for biodiversity issues, both terrestrial and marine, with respect to the NBSAP.
- Key Biodiversity Areas Report
 - ECD within MELAD is the Program of Work on Protected Areas (PoWPA) focal point for Kiribati – it is the lead implementing agency, with assistance from a multi-stakeholder committee of multiple ministry divisions and NGOs within Kiribati. This report provides a regular update on the status of protected areas within Kiribati with respect to national goals for protection, implementation, assessment of key gaps and needs, and action plans for the future.
- PIPA Management Plan 2015-2020
 - This is the main governing document for the Phoenix Islands Protected Area specifically. It provides a vision, principles, management objectives, and a strategic action plan for the protected area within the given time frame. This current version is the second management plan, due to be updated again in 2020. The first plan was developed in 2010 and provides a comprehensive overview of the development of the protected area, key threats, cultural and ecological context, and other useful information on conservation in Kiribati.

The following are the names and status of key legislation that supports environmental management in Kiribati, which could be leveraged and supported by SIO research:

- Wildlife Conservation Ordinance (revised 1977, needs updating)
- Fisheries Ordinance of 1979 (followed by the Fisheries Act of 2010)
- Recreational Reserves Act of 1996
- Environmental Act of 1999 (amended in 2007)
- PIPA Regulations of 2008
- Line Island and Phoenix Island Prohibited Fishing (Bonefish) Regulations
- Draft Revision of the Fisheries Act (currently in review)
- Travel Regulations on Protected Areas (awaiting cabinet endorsement)
- Draft Fishing Regulations (awaiting endorsement)
- Regulations on Protected Areas and Protected Species (awaiting cabinet endorsement)
- Chemical and Waste Management Regulations (currently being drafted)

For more information on key environmental acts, ordinances, policies, and regional and global multilateral agreements and frameworks that Kiribati is part of, please see the *Mandate and Scope of the Policy* section of the Kiribati Integrated Environmental Policy 2015.

Management Gaps and Challenges

Enforcement was unanimously the biggest issue for all agencies we spoke with during the site visit. Specifically, the ability to respond to enforcement events is limited. MFMRD has a satellite screen that is able to track ships around Kiribati's territorial waters – however, considering the huge area, the ability for the appropriate agencies to respond when there is a vessel in question is limited. It takes multiple days to travel between the islands, and they are limited in the number of boats that can travel that distance.

The management agencies in Kiribati have a fairly limited capacity to conduct marine research. The ECD is mostly focused on terrestrial research and management because they don't have the capabilities to do so for marine work. They don't have many staff that are SCUBA certified and they don't have many boats that they can use for research, especially those that can go long distances. There is only one dive instructor and one compressor on Tarawa for all of the government's needs. We also heard unanimously across all agencies that there is a need for technical training. There may be some potential for leveraging partnerships for management technical training with the Marine Training Center or the University of the South Pacific (USP) campus in Tarawa – these may be interesting catalysts. There was also interest in partnering with SIO for technical training, such as vessel training, research techniques, etc.

Funding can also be a challenge among the management agencies in Kiribati. All funding, including money from international fishing licenses, comes a common government pot and gets distributed across the ministries based on their budgets. Over 70% of the GDP for the entire country comes from foreign fishing licenses (Campbell and Hanich, 2014). A large portion of funding for the government also comes from AID money, especially from Taiwan, New Zealand, and Australia. ECD relies heavily on external funding and bilateral aid, mostly for waste disposal and pest eradication. PIPA has somewhat solved this with the PIPA Trust, which is an independent funding entity solely for PIPA that receives annual seed funding from the Waitt Foundation (\$1mil/year), as well as other foundations, organizations, and individuals. Government funds largely go to humanitarian issues, which are understandably a top priority in

Kiribati, and therefore external funding entities (or a coupling therein) are valuable for environmental management.

Another challenge with management and conservation across the country is the discrepancy between the lifestyle on Tarawa and that of the more traditional outer islands. Management agencies are trying to figure out how to get people to care about pristine coral reefs hundreds of miles away (similar to the ‘National Park’ mentality), when they are dealing with major socio-economic problems and sea level rise in their backyard. One interesting development in the future will be figuring out how to get the benefit of marine protected areas and pristine coral reefs in un-developed parts of the country to somehow come back to the people of Kiribati. This is something that the Government of Kiribati and the PIPA partners are working on now.

It seems as though the lines of communication are muddled between the management agencies in Kiribati and external scientists or agencies that conduct scientific research in Kiribati. We heard from multiple agencies that they were aware of research projects or institutes that were conducting specific research in Kiribati waters, but that they had not seen any products or met with those responsible. We also heard that scientists rarely come to meet face-to-face with managers in Kiribati to share their findings and aren’t involved in conservation/management discussions. With their limited capacity for marine work and the vast expanse of ocean that the country constitutes, this means that many of the agencies aren’t entirely sure what marine resources they have in their own backyard.

One success story for environmental management in Kiribati appears to be political support and political will. President Tong has been very committed to tackling environmental issues and bringing international attention to Kiribati’s vulnerability to climate change and also to their pristine marine ecosystems. However, the administration is about to go through a change-over, so this is something to keep an eye on – although we heard from some staff in Kiribati that there is enough support throughout the ministries that the President alone doesn’t necessarily dictate the degree of political support for marine management and conservation. Though we have also heard that there may be some contention among the people of Kiribati that the president is putting too much stress on environmental issues when he should be focused on humanitarian and social issues – though it seems as though the direction that the management agencies may be going would be coupling and maximizing the two.

Upcoming Management Opportunities

Based on current momentum and support for marine conservation in Kiribati, the timing is right to build partnership and invest in science application initiatives there. PIPA just completed its first management plan in 2014 and is now transitioning to the second management plan that started in early 2015. Following PIPA’s implementation and completion of its first management cycle, and riding a wave of high political support, the government of Kiribati is poised to shift their gaze elsewhere for innovative marine conservation initiatives – particularly the Line Islands. The US Pacific Remote Islands Marine National Monument and PIPA made a recent agreement to become “sister sites,” so there is already a potential pathway for the US and Kiribati to share knowledge and capacity for protected area management. SIO’s contribution to this knowledge exchange could be an integral piece of that partnership as well, and researchers from SIO are planning on attending a NOAA Capacity Building workshop in Tarawa later this year to formally present their findings from the Line Islands and initiate dialogue on conservation.

There is growing interest among government and management entities in Kiribati to secure protection for the territorial waters around the Southern Line Islands, following in similar footsteps to the protection process for PIPA. Currently, the commitment from president Tong is to ban commercial fishing within the 12-mile nautical zone around each of the Southern Line Islands, which are home to the healthiest marine areas of the Line Islands (Raab, 2014). There has also been talk among some of the PIPA partners that there may be interest to formally incorporate the Line Islands into PIPA in the long-term, though the Line Islands may require a separate management structure and there has been no formal commitment towards this initiative.

During the trip to Tarawa, I learned about several other national priorities and goals for marine conservation that are currently in development and, with support from the scientific community and other partners, could be implemented in the near future. The Environment and Conservation Division within the Ministry of Environment, Land, and Agriculture Development is in the process of creating an MPA at Cooks Island in Kiritimati. Scientific research on the marine environment there would be extremely helpful to support that initiative and to provide managers and government officials with pros and cons for MPAs. The Fisheries Division within the Ministry of Fisheries and Marine Resources Development recently developed draft Fishing Regulations for nearshore fisheries, and they are hoping to get those regulations endorsed by the government soon. Fisheries officers expressed interest in trainings on fish life history that would help them create effective stock assessments as they further develop their regulations.

Managers in Kiribati were also interested in other SIO research and products that could help inform conservation, such as using coral reef photomosaics to support protected area designations, creating education and outreach materials to increase awareness and build support for conservation across all sectors of society, developing long-term exchanges for students, and building capacity for staff collaborations such as research cruises and grant proposals (discussed in more detail in the following section). Considering their capacity and jurisdictional marine area, Kiribati has done a phenomenal job at conserving and managing their marine treasures. Researchers at SIO have the opportunity to communicate this evidence to create support and pride for managers, students, politicians, and other stakeholders in Kiribati, and to give the nation a stronger voice in the international arena of marine conservation.

Guidelines for Communication

As SIO continues to conduct research in Kiribati, scientists there should ensure that cruise reports or resulting scientific papers are sent to the appropriate agencies in Kiribati in an accessible format. We often heard that cruise reports are not received by the agencies – however, we also heard from scientists that they had sent their reports – so this could be an issue of report archiving on the part of the agencies as well. We also heard from agency staff in Kiribati that it would be helpful to have a shorter blurb, like an executive summary, from findings in those reports. SIO can also help in connecting scientists with management agencies – if SIO scientists are doing research, or are working with people doing research in Kiribati, they should ensure that they let the agencies in Tarawa know what they are doing and what their final report and findings are.

When discussing platforms for communication, it came up frequently that posters and visuals are extremely valuable. We heard that school kids in Tarawa are learning about coral reefs on the Great Barrier Reef instead of their own reefs. In order to instill pride and foster stewardship

among the younger generations, it would be valuable for SIO and partners to provide posters and other visuals that demonstrate their research and findings in Kiribati so that students, managers, and community-members can better understand.

If SIO wishes to continue to play a scientific advisory role in management and conservation decisions made in Kiribati, it would also be helpful to have SIO scientists regularly attending workshops and summits that take place in Kiribati on these issues. It would be valuable for continued communication and partnership if SIO staff could attend and contribute, when possible and relevant, to regular workshops (such as those hosted by CI and the New England Aquarium on PIPA topics), capacity building meetings through NOAA (one has occurred, two more are being planned for late 2015 and potentially 2016), PIPA Scientific Advisory meetings (one is planned for late 2015 and they occur regularly), PIPA Trust meetings (one is scheduled for June 2015 and they occur regularly), meetings of collaborative entities in Kiribati (such as the National Biodiversity Steering Committee, which includes ECD, PIPA, Fisheries Division, Tourism Office, and several others), and even gatherings such as national Education Summits or Curriculum Workshops (both of which took place in Tarawa in May 2015).

Agency staff in Kiribati also expressed interest in collaborating with SIO on research topics. For example, in the future, if there is a PhD at SIO that is interested in some kind of research that may also be useful to the agencies, the two could collaborate on grants. Other ideas for collaboration that came from conversations included student exchanges between SIO and USP, having agency staff on SIO cruises and vice versa (or building capacity/provide training so that Kiribati agency staff may provide support on the cruises), and providing technical training to support management (from SIO directly with the agencies, through the Marine Training Center, or via USP, as mentioned above).

The process by which PIPA was created may be considered a success in science communication in Kiribati. When Greg Stone, then at the New England Aquarium, first came across the Phoenix Islands on an eco-tourism ship out of Fiji, he realized the uniqueness of the untouched marine treasures there. With the help of an interdisciplinary team, he returned to the area on several cruises and brought video, photos, and other documentation back to the ministries and government officials in Kiribati. These face-to-face meetings, where he showed them the treasures that were in their own backyard and explained how they could be protected, started the conversations that led to the collaborative creation of PIPA. This shows the importance of in-person meetings, bringing together the appropriate people, using effective visuals, and building strong and effective partnerships in collaborating with the management agencies in Kiribati.

The SEA Education Association out of Woods Hole may also be considered a model for successful science communication in Kiribati. We heard from ECD staff in Tarawa that the students on the scientific expeditions with SEA Education in the Line and Phoenix Islands have established good communication with the management agencies in Kiribati. The students present their findings to the agency and maintain regular communication through direct contact and social media. This could potentially serve as a model for students at SIO and beyond.

Products Following the Site Visit

There were several follow-up activities that came from the site visit that I was able to accomplish before the end of the MAS program. These products came from discussions we had during the interviews with staff on Tarawa and were intended to show a certain level of commitment for

SIO collaborating with the Government of Kiribati on marine conservation and management topics. They were also intended to test how this partnership may function and what the highest benefit and responsibilities would be for all parties involved.

One such activity included making educational outreach posters for the partners that we met with in Kiribati based on SIO research and information that we gathered during the site visit (see Figure 1 in the Appendix). I developed three groups of posters, with help from agency staff in Kiribati as well as colleagues at SIO. One poster was a concept poster to accompany the coral reef photomosaic posters that we brought to Tarawa during the site visit, and which the Smith and Sandin labs will continue to produce for Kiribati during research cruises. During our site visit, we heard that it would be useful to have a sister poster to accompany the photomosaic posters that explains what they are, how they are created, and why they are useful. I developed this poster with the help of the Sandin Lab and was also able to get it translated into Gilbertese by Betarim Rimon from the PIPA Office.

The second set of posters was created for ECD to support their current sea turtle outreach campaign. The audience for these posters was mostly school children in Tarawa. With help from Ratita Bebe at ECD, I developed two posters: one that showed the life cycle of sea turtles and one that showed how trash harms sea turtles.

The third set of posters was a series of ‘Science and Culture’ posters to support the upcoming PIPA Outreach initiative. The target audience for these posters was community members across Kiribati. The intention was to present the cultural context for three different marine resources in Kiribati – sharks, sea turtles, and the reefs of the Line and Phoenix Islands – and then to marry that cultural connection to scientific findings (largely from SIO research) that support those cultural roles, and also to inform the audience on threats and protection for those resources.

Communication was also maintained with staff in Kiribati and other partners such as CI and the New England Aquarium to ensure that the two-way lines of communication are kept open and to show that SIO is interested in and dedicated to maintaining this partnership as it continues to conduct research in Kiribati.

The Future of Collaboration Between SIO and Kiribati

The long-term goal of this project is to develop a partnership and open the lines of communication between SIO and those responsible for marine management in Kiribati so that scientific information may support local conservation. Making a more dedicated effort to continue that communication, and to build these partnerships to see what may develop in the future, would be extremely valuable over the course of the coming year.

Stuart Sandin and Jennifer Smith from SIO and Forest Rohwer from San Diego State University are planning on attending a NOAA Capacity Building workshop, co-sponsored by the Government of Kiribati, CI, and the New England Aquarium, in August or December of 2015 (final schedule pending) as another step to strengthen this partnership. Taking lessons learned from the Tarawa site visit, they will be presenting on their research from the Line Islands and initiating discussions for action on conservation in that area and collaborations with SIO.

Ideally, in the future, a more formal partnership will be created between SIO and the Government of Kiribati so that SIO may serve in a scientific advisory role for their upcoming management and conservation decisions, particularly with respect to the Line Islands.

Developing a framework such as a collaborative committee or a formal memorandum of understanding would be beneficial. There has been interest from partners in Kiribati, CI, and the New England Aquarium to continue this partnership. Ideally, a staff position or a team of individuals could be created at SIO that is dedicated to maintaining these relationships and to liaising with the management partners to ensure that SIO research continued to be available and useful to them in an appropriate format.

This body of work in Kiribati is a useful starting point from which other such partnerships could be created by SIO, depending on funding and personnel availability. There is an opportunity and a niche that SIO may plan to occupy in the coming years with respect to science application and management liaising, which has not effectively been accomplished by scientific and academic institutions as of yet. My hope is that this initial contact and dialogue may serve as a proof-of-concept and as a model to build upon for these types of partnerships.

V. Conclusion

I learned a great deal during this project, and my hope is that this document becomes a user-guide for continued partnership with Kiribati and that it can be replicated and expanded to apply to other locations around the world where SIO conducts research. There are many upcoming management initiatives in Kiribati where it makes sense to have, and where partners are hoping to have, SIO contribute its research to help inform those decisions. I was extremely pleased to receive such a warm reception from the staff that we spoke with in Kiribati and their partners. Sound science appears to indeed be a capacity gap for the agencies in Kiribati, and they were very open to sharing their opinions, needs, and interests for collaboration with us during the site visit and through continued communication. There is great value in having these in-person discussions and in taking the time to listen to desired partners about what is important to them, what their capabilities are, and what their hopes are for the future. We can only act effectively upon science communication once we first listen to what is needed and desired of those with whom we wish to communicate. This, however, takes a great deal of time and effort – but is crucial to building trust and forming strong lines of communication that serve as a foundation for these types of partnerships.

Timing and capacity are currently aligned to make a concentrated effort to build a partnership between SIO and the management agencies of Kiribati as a model for science application. If this is not addressed, then both parties are losing an opportunity to share capacity and knowledge to inform effective conservation. The interest and momentum are there in Kiribati right now, and they have certain capacity gaps that could be filled by the science being conducted at SIO if it is communicated effectively and available in a format that makes sense to Kiribati partners. Similarly, researchers at SIO have been conducting research in Kiribati for over a decade, and they are at a point where their comprehensive findings could be extremely applicable and valuable to inform upcoming conservation decisions that are being made on the ground. Ultimately, both SIO and the management agencies in Kiribati want to ensure that their marine resources are protected and managed in a way that benefits the nation of Kiribati and its people long-term. There is a unique opportunity for SIO and Kiribati to work together to build this science-application partnership that could serve as a model for scientific research to become available and applicable to managers worldwide.

In my opinion, the most exciting thing about this project is the potential for expansion and replication. One of the unique and wonderful things about SIO is the wide range of ecosystems and regions where it conducts research, as well as its credibility. With that diversity and widespread recognition comes the power to inform decisions and affect positive change in many different areas. There are scientists at SIO that conduct research in the Arctic, the Caribbean, the Gulf, and in environments both above and below the water all over the world. In the past year, I have experienced the value of having a direct conduit between science and management to make sure science is available and useful in an effective format to those that need and want it. SIO could be helping to ensure that managers and other stakeholders around the world have the information and tools that they need to make their own informed decisions on the future of their oceans. In order for science to become and remain relevant in the management and conservation world, I think that this line of work would be an extremely valuable, and yet unfilled, niche for SIO to occupy. I have experienced growing momentum and interest for this type of applied science, in Kiribati and beyond, and I look forward to seeing where SIO goes from here and hopefully continuing to be a part of it.

VI. References

- Andreassen, H. 2013. *Challenges in Applied Ecology*. Hedmark University College.
- Barott KL, Caselle JE, Dinsdale EA, Friedlander AM, Maragos JE, et al. (2010). The Lagoon at Caroline/Millennium Atoll, Republic of Kiribati: Natural History of a Nearly Pristine Ecosystem. *PLoS ONE* 5(6): e10950. doi:10.1371/journal.pone.0010950
- Barott, K., G. Williams, M. Vermeij, J. Harris, J. Smith, F. Rohwer, S. Sandin. (2012). Natural history of coral–algae competition across a gradient of human activity in the Line Islands. *Marine Ecology Progress Series*. Vol. 460: 1–12, 2012. doi: 10.3354/meps09874
- Bonasio, A. 2015. *Avoiding Research Pitfalls: Kristen Marhaver Talks @ Mendeley*. <<http://blog.mendeley.com/talks-at-mendeley/avoiding-research-pitfalls-kristen-marhaver-talksmendeley/>>
- Campbell, B. and Hanich, Q. (2014). *Fish for the future: Fisheries development and food security for Kiribati in an era of global climate change*. WorldFish, Penang, Malaysia. Project Report: 2014-47.
- Cook, C., M. Mascia, M. Schwartz, H. Possingham, and R. Fuller. 2013. Achieving Conservation Science that Bridges the Knowledge–Action Boundary. *Conservation Biology*. 27(4): 669–678. Published online 2013 Apr 10. doi: 10.1111/cobi.12050
- DeMartini, E., A. Friedlander, S. Sandin, and E. Sala. (2008). Differences in fish-assemblage structure between fished and unfished atolls in the northern Line Islands, central Pacific. *Marine Ecological Progress Series*. Vol. 365: 199–215, doi: 10.3354/meps07501
- Dinsdale EA, Pantos O, Smriga S, Edwards RA, Angly F, et al. (2008). Microbial Ecology of Four Coral Atolls in the Northern Line Islands. *PLoS ONE* 3(2): e1584. doi:10.1371/journal.pone.0001584
- Friedlander, A., S. Sandin, E. DeMartini, and E. Sala. (2010). Spatial patterns of the structure of reef fish assemblages at a pristine atoll in the central Pacific. *Marine Ecology Progress Series*. Vol. 410: 219–231, 2010. doi: 10.3354/meps08634
- Johnson, A. E., Cinner, J. E., Hardt, M. J., Jacquet, J., McClanahan, T. R. and Sanchirico, J. N. (2013), Trends, current understanding and future research priorities for artisanal coral reef fisheries research. *Fish and Fisheries*, 14: 281–292. doi: 10.1111/j.1467-2979.2012.00468.x
- Raab, L. (2014). Island nation of Kiribati bans commercial fishing in part of Pacific. *Los Angeles Times*. URL: <<http://www.latimes.com/science/sciencenow/la-sci-sn-fishing-ban-pacific-kiribati-20140617-story.html>>
- Rotjan, R., R. Jamieson, B. Carr, L. Kauffman, S. Mangubhai, D. Obura, R. Pierce, B. Rimon, B. Ris, S. Sandin, P. Shelley, U. Sumaila, S. Taei, H. Tausig, T. Teroroko, S. Thorrold, B. Wikgren,

T. Toatu and G. Stone. (2014). Establishment, Management, and Maintenance of the Phoenix Islands Protected Area. *Advances in Marine Biology*. Vol. 69. ISSN 0065-2881.

Roux, D. J., K. H. Rogers, H. C. Biggs, P. J. Ashton and A. Sergeant. 2006. Bridging the science–management divide: moving from unidirectional knowledge transfer to knowledge interfacing and sharing. *Ecology and Society* 11(1): 4. [online] URL: <<http://www.ecologyandsociety.org/vol11/iss1/art4/>>

Ruttenberg BI, Hamilton SL, Walsh SM, Donovan MK, Friedlander A, et al. (2011) .Predator-Induced Demographic Shifts in Coral Reef Fish Assemblages. *PLoS ONE* 6(6): e21062. doi:10.1371/journal.pone.0021062

Sandin SA, Smith JE, DeMartini EE, Dinsdale EA, Donner SD, et al. (2008). Baselines and Degradation of Coral Reefs in the Northern Line Islands. *PLoS ONE* 3(2): e1548. doi:10.1371/journal.pone.0001548

Smith, J., M. Shaw, R. Edwards, D. Obura, O. Pantos, E. Sala, S. Sandin, S. Smriga, M. Hatay, and F. Rohwer. (2006). Indirect effects of algae on coral: algae-mediated, microbe-induced coral mortality. *Ecology Letters*. 9: 835–845 doi: 10.1111/j.1461-0248.2006.00937.x

Walsh, S. (2011). Ecosystem-Scale Effects of Nutrients and Fishing on Coral Reefs. *Journal of Marine Biology*. Volume 2011, Article ID 187248, 13 pages. doi:10.1155/2011/187248

Wegley, L., K. Barott, E. Dinsdale, A. Friedlander, B. Nosrat, D. Obura, E. Sala, S. Sandin, J. Smith, M. Vermeij, G. Williams, D. Willner and F. Rohwer. (2012). Black reefs: iron-induced phase shifts on coral reefs. *The International Society for Microbial Ecology Journal*. Vol. 6, 638–649.

VII. Appendix

Table 1: Contacts Prior to Site Visit

Name	Organization	Position	Email Address
Stuart Sandin	Scripps Institution of Oceanography	Associate Professor, Lab PI	ssandin@ucsd.edu
Jen Smith	Scripps Institution of Oceanography	Associate Professor, Lab PI	smithj@ucsd.edu; jes013@ucsd.edu
Forest Rohwer	San Diego State University	Professor, Lab PI	frohwer@gmail.com
Nancy Knowlton	Smithsonian Institution	Sant Chair for Marine Science	knowlton@si.edu; knowltonn@gmail.com
Randi Rotjan	New England Aquarium	Associate Research Scientist	randi.rotjan@gmail.com
Reagan Jamison	New England Aquarium	Conservation Programs Manager	rjamieson@neaq.org
Greg Stone	Conservation International	Head of the Marine Program	gstone@conservation.org
Sue Taei	Conservation International	Executive Director, New Zealand and Pacific Islands	staei@conservation.org
Schannel van Dijken	Conservation International	Senior Marine Program Manager, Pacific Islands and Oceans Program	svandijken@conservation.org
Eleanor Sterling	American Museum of Natural History	Chief Conservation Scientist, Center for Biodiversity & Conservation	sterling@amnh.org
Dan Brumbaugh	American Museum of Natural History	Visiting Scientist	dbrumbaugh@amnh.org
Nadav Gazit	American Museum of Natural History	Research & Production Assistant, Center for Biodiversity and Conservation & the Network of Conservation Educators and Practitioners	ngazit@amnh.org
Mary Sue Brancato	NOAA	Office of Ocean and Coastal Resource Management; NOAA's International Marine Protected Area (MPA) Capacity Building Program	mary.sue.brancato@noaa.gov
Sheila Walsh	The Nature Conservancy	Senior Scientist for Sustainability	sreddy@tnc.org

Patty Elkus	Mission Blue; SIO	Board Member	pattyelkus@aol.com
Amber Jackson	Anthropocene Institute	Marine Scientist	amberleajackson@gmail.com
Emily Callahan	Coastal Environments	Project Scientist	eadcallahan@gmail.com
Stephanie Roach	Waitt Institute	Program Manager	sroach@waittinstitute.org
Erika Rosenthal	Earth Justice	Staff Attorney	erosenthal@earthjustice.org
Marea Hatzios	World Bank (retired)	Senior Coastal and Marine Specialist	Marea.hatzios@gmail.com
Tim White	Graduate Student	Hopkins; Previous Tech with Doug at UCSB and Stanford	whitetdm@gmail.com; timwhite@stanford.edu
Douglas McCauley	UC Santa Barbara	Assistant Professor, Ecology, Evolution, and Marine Biology	douglas.mccauley@lifesci.ucsb.edu

Table 2: In-Person Interviews in Tarawa

Name	Organization	Position	Email Address
Taibo Taakee	Ministry of Education		taakeetaibo@gmail.com
Tukabu Teroroko	PIPA Office	Head of Phoenix Islands Protected Area Trust	tukabut@gmail.com
Marii Marae	Environment and Conservation Division, MELAD	Acting Deputy Director ECD	mariim@environment.gov.ki
Ratita Bebe	Environment and Conservation Division, MELAD	Wildlife Officer (based on Kiritimati)	taibwa@gmail.com; ratitab@environment.gov.ki
Tenikoiti Kaitu	Environment and Conservation Division, MELAD	National Biodiversity Strategic Action Plan (NBSAP) Project Coordinator	tenikoitik@environment.gov.ki
Robite Teate	Environment and Conservation Division, MELAD	Environment Awareness Officer, Head of Media and Public Awareness Unit	robitet@environment.gov.ki
Taati Eria	Fisheries Division, MFMRD	Senior Fisheries Officer	taatie@fisheries.gov.ki; taatieria@gmail.com
Reeti Onorio Rui	Kiribati National Tourism Office, MCTTD	Director of Tourism	ronorio@kiribatitourism.gov.ki

Table 3: Contacts Made During Site Visit and through Follow-up Interactions

Name	Organization	Position	Email Address
Bibiana Bureimoa	Ministry of Education	Ag. Director of the Curriculum Development & Assessment Division (CDAD)	bbbkaiea@gmail.com
Baraniko Namanoku	Ministry of Education	Curriculum Development Official	bnamanoku@gmail.com
Betarim Rimon	PIPA Office	Education and Outreach	temamaka@gmail.com
Katareti Taabu	Environment and Conservation Division's Wildlife Office on Kiritimati, MELAD	OIC on Kiritimati	teeirak@gmail.com
Natan Itonga	Kiribati School System	HS Teacher, previously the Cultural Officer for Kiribati	natitonga@hotmail.com
Ben Namakin	SPC Fisheries	Representative on Tarawa	tammy.ahleiomi@gmail.com ; benn@spc.int
Tarateiti	SPC Fisheries	Representative on Tarawa	tarateitiu@spc.int
Tawita Temoku	Ministry of Line and Phoenix Islands Development	Minister	ttemoku@gmail.com
Wiriki Tooma	Ministry of Line and Phoenix Islands Development	Secretary	wiritaake20@gmail.com
Taouea Rehier	Environment and Conservation Division, MELAD	Acting Director of ECD	taouear@environment.gov.ki
Taulehia Pulefou	Environment and Conservation Division, MELAD	Acting Deputy Director of ECD	taulehiap@environment.gov.ki

Figure 1: Education and Outreach Posters

Coral Reef Photomosaic Concept Posters (English and Gilbertese):

Widening Our View of the Reef: PhotoMosaics

Scientists from the Scripps Institution of Oceanography in California are using new photography to explore coral reefs. Thousands of photographs of the reef are combined using computer programs to create a single photomosaic. These photomosaics provide a view of almost the entire reef and contain thousands of corals. By returning to the same location every year and taking new photographs, we can follow the life of each coral. Our goal is to study many islands across the Pacific Ocean so that we understand how reefs work in different places. This knowledge will help us protect coral reefs and the goods they provide for future generations.

For more information please contact Dr. Stuart Sandhu (ssandhu@ucsd.edu) or Rita Orbach (rora@ucsd.edu).

Photomosaic taken in 2012 at Tanna Island
1 meter

This picture is the same reef shown above, but converted into a mosaic of different coral species. By comparing photos from the same reefs each year, we can study how and why reefs change.

New photomosaic technology allows us to make very large images of the ocean floor.

Most coral reef science has been done using small photos.

Thousands of photos are taken by SCUBA divers swimming with cameras.

While very useful, these pictures usually only contain what is in front of the camera. There are actually thousands of corals, so these small pictures don't show the whole reef.

Expert ocean scientists study these photos to get scientific information.

Karabaaban ara atatai iaon taian rakai ma taian ane: PhotoMosaics (Tamnei aika tomatomaki)

Taan rabakau man te Scripps Institution of Oceanography California a tia n karekea te rabakau ac boou are a kabongana iai te bwai n rawe tamnei ac bou ac kona n rawea tamnein te kaora ac moan te buburakaci ao ni kaotinaoko bwa teuanu te tamnei teuanu iaon te beba. Ni karaaoan aio ao ikai are a kona iai n raweaki tamnein taian kaora n te aono ac moan te bubura ao man kaotinaokoaki iaon te beba. Imwin te tai ac maan ao a kona ni manga okirai taian kaora ake a tia n rawetamneiaki akame ao ni manga moan raweaki kaa tamneia. Man tamnei akana tuou akame aika a raweaki n taai aika a kakaokoro ao e kona n noraki iai ngkame bwa iai aorakin ke rotakin taian kaora ma rakai ma ane akame ke ake. E na karaokaki te rawe tamnei aio iaon kaoran nako maruwan te Betebeke bwa te anga teuanu ac bou abukin tutaon marurungin taian rakai ma kaora.

For more information please contact Dr. Stuart Sandhu (ssandhu@ucsd.edu) or Rita Orbach (rora@ucsd.edu).

Tamnei aika tomatomaki aiki a karauaki i Tabuaraa
Teuanu te mita

Maia bwa tomatomaki man ake akame ma a ia n taian tomatomaki a kabongana iai te bwai n raweaki tamnein taian kaora n te aono ac moan te bubura ao man kaotinaokoaki iaon te beba. Ni karaaoan aio ao ikai are a kona iai n raweaki tamnein taian kaora n te aono ac moan te bubura ao man kaotinaokoaki iaon te beba. Imwin te tai ac maan ao a kona ni manga okirai taian kaora ake a tia n rawetamneiaki akame ao ni manga moan raweaki kaa tamneia. Man tamnei akana tuou akame aika a raweaki n taai aika a kakaokoro ao e kona n noraki iai ngkame bwa iai aorakin ke rotakin taian kaora ma rakai ma ane akame ke ake. E na karaokaki te rawe tamnei aio iaon kaoran nako maruwan te Betebeke bwa te anga teuanu ac bou abukin tutaon marurungin taian rakai ma kaora.

New photomosaic technology allows us to make very large images of the ocean floor.

Most coral reef science has been done using small photos.

Thousands of photos are taken by SCUBA divers swimming with cameras.

While very useful, these pictures usually only contain what is in front of the camera. There are actually thousands of corals, so these small pictures don't show the whole reef.

Expert ocean scientists study these photos to get scientific information.

Sea Turtle Conservation Posters for ECD:

Sea Turtles and Trash

Can you tell the difference?
Sea turtles can't.

Sea turtles die from accidentally eating our trash that ends up in the ocean. Protect our sea turtles by always disposing of your trash and never leaving it on the ground!

Sea turtles can get caught in fishing nets or on longlines. Never leave your nets or hooks in the ocean after fishing.

Photo Credit: Taylor Madalene and Chad Hamilton-Koll, Scripps Institution of Oceanography

Sea Turtle Life Cycle

We share our environment with sea turtles. Like us, they depend on both the land and sea throughout their lives. Sea turtles in Kiribati are endangered, and it is our job to help conserve them for future generations.

Human activity, like building on beaches and disturbing nesting areas, can prevent females from laying their eggs or kill the babies before they hatch.

We must make sure to only harvest what we need. If we take too many sea turtles, their populations will go down.

Mating (20-50 years old)

Females lay their eggs in a nest on the beach

Females return to the sea after laying their eggs

Hatchlings (8-10 weeks after being laid)

Migration as Juveniles (5-10 years old)

Foraging Adults

Sea turtles can get caught in fishing nets or on longlines. Never leave your nets or hooks in the ocean after fishing.

Photo and Artists: Credit: Taylor Madalene and Chad Hamilton-Koll, Scripps Institution of Oceanography

Science and Culture Posters for PIPA (English and Gilbertese):

Kiribati's Ocean, Kiribati's Identity

Bakoa - Protector of the Ocean and Kiribati

CULTURE

Sharks are powerful and important animals that embody the spirit of the I-Kiribati and connect us to our ancestors. Traditionally, sharks represent the I-Kiribati protecting and managing our marine resources. Just like the shark boti distributing the seasonal fish harvest at the maneaba, sharks protect and control the population of fish in our ocean. In traditional Kiribati dances and magical chants, sharks bring balance and order to the community, just as they do on our coral reefs.

SCIENCE

Scientific research shows what our ancestors have known for generations – that sharks play a critical role as top predators to help maintain our ocean's biodiversity. They eat the weaker and unhealthy fish, allowing our ocean to produce large amounts of healthy fish. Sharks are some of the most ancient animals on the planet. There are over 20 shark species found in Kiribati. Ten of those shark species are listed on the IUCN Red List as being at risk of extinction.

CONSERVATION

The Phoenix Islands Protected Area (PIPA) is known as the Noah's Ark for sharks, protecting some of the world's largest and most abundant shark populations. Unfortunately, Kiribati's shark population is rapidly declining, likely due to overfishing and illegal shark finning. Humans kill almost 100 million sharks every year around the world. Without sharks, other fish populations may disappear and our coral reefs will no longer be healthy and beautiful. If we lose our sharks, we lose our healthy reefs and an important part of our ancestral legacy. We must protect them, as they protect our oceans.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.uclsd.edu | www.phoenixislands.org | www.environment.gov.ki
 Design Credit: Taylor Middlemore and Chase Martin, Scripps Institution of Oceanography

Marawa, Rikian te I-Kiribati

Bakoa ae rikian te I-Kiribati bon te tia kawakina marawa

TE KATEI NI KIRIBATI

Te Bakoa bon bannaia ara ikawai ma aroia ae te tararua marin marawa bwa e na teimatoa nakoira ni kabane inanon roroo ma roroo. E tei te Bakoa bwa te tia uota te raoi ao te rau inanon marawa ike a babairekai raoi iai aroia ika n aekaia nako bwa a na teimatoa n taai nako.

RABAKAU AIKA BOOU

A kunea taan rabakau bwa moan te eti aia kukune ara ikawai ngke a kaman kunea te Bakoa bwa e kakawaki tabena ni kateimatoan marin marawa ibukin kanara te ika bwa e na teimatoa n taai nako ao inanon roroo nako. Te Bakoa e katoki tabereia ika ake a ioawa nakoia ika ake a uarereke ao e tringia naba ika ake a aoraki-buaka n te aro bwa e na teimatoa ni marurung marawa ma marina n taai nako. Iai 20 aekakin Bakoa aika a maiu i Kiribati ao 10 mai iai ae iaon kawaina ni bua matana imwin anaakina n akea te katautau.

KAMANOMANO

Te Aono n Rawaki ae Ana Okai ni Marawa Kiribati kanga ai aron ana Aake Noa ike a kamanooki iai Bakoa ma ika n aroia nako. E kakawaki alo ngkai n taai aikai ao moan te korakora anaakin te Bakoa n te aro ae aki riarii ao n akea te katautau. Ti riarii n boutoka alo bwa ngkana akea te Bakoa ao e na rongo iai marawa ao e na bua naba iai rikiana ni Kiribati are ti maiu mai taari n taai nako.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.uclsd.edu | www.phoenixislands.org | www.environment.gov.ki
 Design Credit: Taylor Middlemore and Chase Martin, Scripps Institution of Oceanography

Kiribati's Ocean, Kiribati's Identity

Tabwakea - The People, Land, and Soul of Kiribati

CULTURE

The sea turtle represents the I-Kiribati and the country of Kiribati together as one. To love and protect the sea turtle is to love and protect our cultural identity. In the Kiribati Creation Narrative, the turtle is the body of the bo-ma-te-makii, forming heaven, the earth, and the ocean. Like the I-Kiribati, turtles depend on both the land and the sea to survive. Kiribati is the Land of the Turtles (*Aban Tabwakea*); by protecting turtles we become custodians of our natural environment and our cultural heritage.

SCIENCE

Science also recognizes the important role sea turtles have in our oceans. Turtles keep coral reefs healthy by controlling the amount of algae and sponges on the reef. They also transport nutrients between shallow lagoons and the deeper coral reefs, strengthening the connection between land and sea. Kiribati is home to important sea turtle nesting locations, such as in North Tarawa. Sea turtles are an ancient species that has been navigating and nurturing our ocean for millions of years.

CONSERVATION

The sea turtle populations that our ancestors cherished are in decline. Sea turtles are at risk from overharvesting, from eating plastic bags and other trash, and from getting caught in fishing nets. Kiribati is home to two species of sea turtle that are globally recognized as endangered. By respecting and protecting sea turtles, we take care of our land, our culture, and our families.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.uclsd.edu | www.phoenixislands.org | www.environment.gov.ki
 Design Credit: Taylor Middlemore and Ali Khen, Scripps Institution of Oceanography

Marawa, Rikian te I-Kiribati

Kiribati Bona Aban Tabwakea

TE KATEI NI KIRIBATI

Tabwakea bon te man ae te On are bon tamnein te I-Kiribati ni koaua. Kamaano te On bon kateimatoan naba kateira ma rikiana ni I-Kiribati. E maiu man maeka te On ke Tabwakea i taari ao iaon te aba naba. A taku tabeman bwa boran te On Tabwakea kanga ai aron te Bo-ma-te-makii are a karikaki iai Aonnaba. Eng, Kiribati bon aban Tabwakea ao kateimatoan ma kamaano te man ae On tiaki ti kateimatoan kanara ma bon kateimatoan naba ara otawanin ma rikiana ni I-Kiribati - are ti na teimatoa n nora tamneina iroun te man ae te On.

RABAKAU AIKA BOOU

A kunea taan rabakau bwa te man ae te On ke Tabwakea e bon nang ni kakawaki naba tabena ibukin ara marawa. E kateimatoai maiun taian rakai ma taian ane n arona ni kang taian nimroona ao onga-n-tari ake a maiu iaon taian rakai man kona ni kamatei taian ane. Tiaki ti ngaia ma te man ae i uouoti naba taian nutrients ke taian mari man aono aika ora nakaon aika a iauboti ke man taabo ake a nano nakon taabo ake a ora. E kinaaki Kiribati bwa te aba teuana ae rawata ana tabo ni bung te On iai, n aron ae i Tarawa i Eta. Te On bon te ika ke te man ae nang maan n riki n te aonnaba ao e tia ni boborau inanon marawan aonnaba inanon mirion te ririki.

KAMANOMANO

E kakoauaki bwa e a kerikaki mwaifin te On inanon marawa ni kabotauaki ma are a tanaei n noria ara bakatibu. E riki aei mai mwin anaakina n te aro ae aki tatiianaki. Tiaki ti ngaia ma e rawata naba te On ae mate ibukin kanakin taian buraetiki ma mange riki tabeua ake a kakarenakoaki i taari. A mwaifin On aika a mwane man mate naba n taian karau n akawa. E kakawaki totokoa kanganga aikai bwa e aonga ni mano te man aei are bon kanara ao bon bannan naba te I-Kiribati.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.uclsd.edu | www.phoenixislands.org | www.environment.gov.ki
 Design Credit: Taylor Middlemore and Ali Khen, Scripps Institution of Oceanography

Kiribati's Ocean, Kiribati's Identity

The Phoenix and Line Islands - The Okai of Kiribati

CULTURE

The healthy coral reefs in the Phoenix and Line Islands represent the treasure and bounty of Kiribati. The Phoenix Islands Protected Area (PIPA) acts as Kiribati's national okai. It provides a safe and protected place for marine and terrestrial species to grow. Like an okai, PIPA's protected resources then reproduce and spread to areas around PIPA, providing a wealth of food and goods to Kiribati and other nearby nations. This embodies the sharing nature of the I-Kiribati and our ancestors.

SCIENCE

The Phoenix and Line Islands have some of the healthiest and most beautiful coral reefs on the planet – more than even the Great Barrier Reef! Our ocean okai is home to hundreds of coral and fish species. Some species found on our islands, like the Kiritimatī Reed-Warbler, are endemic and are not found anywhere else on the planet. Many of our animals, like the Green Sea Turtle, are listed on the IUCN Red List as Endangered. By protecting our ocean okai and all of the species that live there, we are providing resources for our people and keeping our ocean healthy.

CONSERVATION

The Phoenix Islands Protected area is the second largest marine protected area in the world. It is also the largest and deepest World Heritage Site. The Line Islands could become a similar protected area in the future. It is critical that we have these protected areas so that our ocean animals are able to rest and reproduce. The benefit goes beyond the borders of Kiribati, helping to balance ocean environments throughout the region. This keeps our ocean healthy and protects our cultural legacy, for generations to come.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.edu/cmb | www.phoenixislands.org | www.environment.gov.ki

Design Credit: Taylor Maddox and Aali Khan, Scripps Institution of Oceanography



Marawa, Rikian te I-Kiribati

Te Aono n Rawaki - Ana Okai ni Marawa Kiribati

TE KATEI NI KIRIBATI

Maiu reirein rakain ao marawan te Aono n Rawaki e a bon kaota naba aron maiu reirein aban ma marawan Kiribati. Te PIPA e riki ngkai bwa kanga Ana Okai te I-Kiribati ike a kawakinaki rabi lai man kamanokai marin naba taari ma marawa. Aio te Okai are a kawakinaki lai ika bwa a na kona ni kariki man kamwaitia ao n taonako naba n te aro bwa e na aki tatere te ika man marawan Kiribati ao man reke naba onoaia aaba ake I'thianikin Kiribati - man taonakon te ika mai inanon te PIPA. Ika are e a kaotaki naba lai rikian te Kiribati mangkoa ae e rabakau te maiu ni katautau ao te maiu naba n ttiuraoi.

RABAKAU AIKA BOOU

Te Aono n Rawaki bon teuana te tabo laon te buraneti aei ae rianako mwaltin iika, rakai ao mannkiba aika nang maiureirei. E korakora te maiu ika ni kabotauki ma ana Okai ni Marawa Aotteria ae te Great Barrier Reef. Ara Okai ae te PIPA e riki bwa mwenga bubua ma bubua aekakia nako ma rakai ao talan ane. E riki naba bwa mwengaia mannkiba aika nang ni mwalti n aron te mannkiba ae te reed-warbler ae aeka aekakina n te aonnaba aei bwa e ti riki ao ni maeka i Kiritimatī ao n te Aono n Rawaki. Te On Tabwakea (green turtle) maon te rawata naba n Aono n Rawaki e nage ngke e kakaouaki irovia taan rabakau bwa laon kawaina nkai ni bwa matana man te aonnaba aei. Kateimatoan ao kawakinan te PIPA ma kanoana ni kabane bon kateimatoan mwaltin kanara ao kateimatoan ara marawa bwa a na teimatoa ni maiureirei.

KAMANOMANO

Te Aono n Rawaki ae ana Okai ni Marawa Kiribati e riki ngkai bwa te kauous n Okai ni Marawa ae moan te buburakaei n te aonnaba aei. E ngea n ane ao e bon teimatoa n riki bwa bwa te Okai ni Marawa ae te kabanea ni bubura ao n nano man iabuti ae tauaki mwina n Bootakin te Aonnaba (World Heritage). Te Aono n Raina e bon nang ni kaubwai naba n te maiu ao lai tarakina bwa e nang n tau naba n riki bwa reitan ana Okai ni Marawa Kiribati ae te PIPA nakon taai aika a na roko. E kakawaki ataakin aei ao kateimatoan Ara Okai ni Marawa ngkai aio e riki bwa aia tabo ika, rakai ma talan mannkiba ni kamanokai ao ni kaabung. E korakora te kabwala ae na reke man aio bwa e kabaerantaki raii lai maiureirein te enwaeromenta laon Kiribati ao n te Betebeke. Tiaki ti ngaia ma ara Okai ni Marawa ae te PIPA e kateimatoa maiureirein marawan Kiribati are ti teimatoa ni maiu lai mangkoa, ngkai ao nakon taai aika a na roko.

This poster was created by Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation in collaboration with the Government of Kiribati. For more information, please visit our websites: www.scripps.edu/cmb | www.phoenixislands.org | www.environment.gov.ki

Design Credit: Taylor Maddox and Aali Khan, Scripps Institution of Oceanography



Figure 2: Organizational Chart of the Kiribati Government as it relates to Environmental Management

