Oceania Project

A Network of Marine Conservation Agreements

Toward resilient coral reefs, enhanced human well-being

Project Prospectus by

NaturalEquity©

Acknowledgements

We thank individuals who contributed valuable time, ideas, insights, information, and humor- where necessary:

Dr. Satie Airame, Policy Coordinator, Marine Science Institute, UC Santa Barbara
Mr. Wayne Andrew, Congressional Delegate, Republic of Palau
Mr. Charles Chieng, Executive Director, Yap Community Action Program (Yap CAP)
Ms. Vanessa Fread, Environment Program Development Officer, Yap CAP
Dr. Steve Gaines, Director, Marine Science Institute, UC Santa Barbara
Dr. Heidi Gjertsen, Economist, NOAA Southwest Fisheries Science Center
Dr. Ted Groves, Director, Center for Environmental Economics, UC San Diego
Ms. Tiare Holm, Executive Director, Palau Conservation Society
Dr. Nancy Knowlton, Chair of Marine Science, Smithsonian National Museum of Natural History
Mr. Willy Kostka, Director, Micronesia Conservation Trust
Mr. Sebastian Marino, Traditional Chief, People of Tobi, Republic of Palau
Dr. Eduard Niesten, Director, Conservation Economics Program, Conservation International
Ms. Julie Risien, Research Coordinator, Oregon State University, Oregon Sea Grant
Dr. Jason Scorse, Chair, International Environmental Policy Program, Monterey Institute of International Studies, an affiliate of Middlebury College
Dr. Kevin Starr, Rainer Arnhold Fellows Program, Mulago Foundation
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September, 2009

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***Left to right**: (i) Children, Ngulu Atoll, Yap (ii) Reef fish catch, Papua New Guinea, and (iii) Mr. Sebastian Marino, Traditional Chief, People of Tobi, Palau, speaking about conservation agreements at a 2007 meeting.*

[1] We define marine conservation agreements to include "community conservation agreements" and "conservation incentive agreements". By long-term we mean an agreement that lasts 20 years or longer.

SUMMARY

Key Principles of the Oceania Project

1. The unavoidable **opportunity cost**[2] of long-term biodiversity conservation must be sustainably addressed.
2. **Resource owners need to see how they will benefit** in the short term and must retain full control over their resources.
3. In an era of climate change, **targeted science** is a necessary condition for effective monitoring and management for ecological resilience.
4. Where resource owners are willing, the abovementioned can be efficiently and equitably addressed with **marine conservation agreements (MCAs)**.

Coral reef owners face a multitude of challenges posed by encroachment and illicit fishing, over-exploitation of marine resources, marine pollution, sedimentation, climate change, and maintaining or raising living standards in the face of declining resources. Moreover, coral reef owners often work in isolation to protect and manage coral reefs-globally valued natural assets. Meeting these challenges requires innovation, coordination, and steady financing that can be beyond what coral reef owners can muster working alone. In response, we outline a highly direct approach that combines the resources of coral reef owners, a global community of coral reef investors, and scientists to achieve four (4) objectives at a network of strategically selected sites:

- Virtual elimination of illicit fishing and over-exploitation of marine resources
- Support for coral reef owners in their efforts to innovatively manage, monitor, and protect their reefs, and provide means for advancing socioeconomic well-being
- Sustainable and predictable financing that is performance-based, transparently audited, and lasts 20 years or longer
- Application of scientific as well as traditional knowledge to manage reefs for maximum ecological resilience and facilitate adaptation to climate change

[2] The sum of all that is given up in order to achieve desired conservation outcomes, e.g., costs of lower rates of consumptive extraction, adequate surveillance and enforcement, and scientific monitoring and adaptive management.

Our approach is to strike long-term marine conservation agreements (MCAs) with willing coral reef owners at suitable existing projects. MCAs are essentially *quid pro quo* transactions in which coral reef owners receive steady financing for management, monitoring, and social investments in exchange for verifiable commitments to the abovementioned objectives. MCAs offer high-quality employment and capacity development, devolve project control and authority to coral reef owners, and guarantee that long-term financing will be available to owners who maintain their commitments. We go beyond performance payments by providing linkages to successfully demonstrated community-based development approaches and access to technology that enhances the capacity of coral reef owners to protect their reefs and make more astute social investments. We accomplish this by engaging existing organizations with proven successes that can be applied at our project sites. In summary, we describe the approach as:

A. Highly direct: the agreement is a *quid pro quo* transaction- coral reef owners receive benefits in exchange for verifiable management and conservation
B. Able to meet the needs of Pacific Islanders: social investments and technology access are included in the benefits package tied to an agreement
C. Long-term: agreements are for at least 20 years and renewable
D. Bottom-up empowering: project control is devolved to coral reef owners, who have ultimate responsibility for management and monitoring
E. Replicable: a model that demonstrably enhances human well-being and helps protect community resources will generate demand for similar partnerships (agreements) from other communities of coral reef owners
F. Sustainable: the approach maintains or enhances the ecological platform of the local economy, culture, and heritage at our project sites
G. Performance-based: financial flows and support are contingent upon compliance with the agreement, verified through a third party

We propose a strategy for taking the approach to scale by first demonstrating a successful MCA with the Helen Reef project located in Palau, Micronesia. We will then develop a "proof-of-concept" network of three MCAs in Micronesia that can be replicated in other

regions of Oceania. We will replicate and scale a network of projects according to a strategy that considers ecological, biophysical, and human factors. For example, we will consider the existing ecological status of reefs, inherent productivity, oceanographic and physical conditions, and taxonomic diversity of hard corals and associated species. In terms of the human dimension, we will consider the strength of local leadership, community representation and interest in the MCA approach, opportunity costs of conservation, and perceived extinction risk for hard coral species[3]. Ultimately, we target a network size and configuration that will result in a robust set of ecologically functional and taxonomically diverse hard coral assemblages over the next 25-50 years, given the anticipated severity and uncertainty of the challenges we address, notably climate change.

We recognize logistical and capacity constraints, especially the scarcity of local capacity and difficulty of growing and sharing existing capacity over a network of spatially scattered and remote sites. In response, we will construct or work within existing social networks that support local capacity sharing and development, facilitate the study of reefs on large spatial and temporal scales according to a common research/monitoring design, and feed information back to coral reef owners so it can be applied to management. Information feedback is essential to successful adaptation to climate change. For example, the ecological response to existing patterns of human extraction may shift in response to climate change, which could lead to a recommendation for altering patterns of consumptive extraction, e.g., fishing.

We also outline a financing model that can be iteratively developed through the course of model demonstration, replication in Micronesia, and scaling throughout Oceania. Our financing model recognizes and addresses two overriding challenges (i) the difficulty in attracting investments that can be used to capitalize endowed funds, which is often the case with cash grants opportunities (most foundations prohibit use of funds to capitalize endowments), and (ii) the potential need to attract new sources of investment that may be required to finance a network of MCAs in Micronesia of sufficient size to ensure that

[3] We refer to local extinctions that could result from an ecological phase shift from hard coral assemblages (Scleractinian spp.) to communities dominated by algal species.

coral reefs in the region are resilient to climate change over the next 25-50 years (even when the most cost-effective measures are taken).

Our short-term strategy is to raise the funds necessary to strike three agreements, pilot social investments, develop an initial social network, and complete a proof of concept for Micronesia. We will then develop a core consortium of "coral reef investors" who capitalize a fiduciary trust (endowment fund) required for long-term, sustainable financing of the initial network.

We present plans to develop a decentralized global enterprise to service the MCA network, comprised of a small NaturalEquity staff based in California, members of our partner organizations in Palau and Yap, and a select group of scientists. The structure of the enterprise emphasizes regional capacity development, cost saving by sharing costs and reducing travel between the US and Micronesia, and a high degree of autonomy and control by region-based entities.

Finally, we introduce a novel concept for uniting and leveraging a global community of coral reef investors. Recognizing that this would be a highly competitive endeavor, we aim to provide investors with a novel experience worth paying for:

1. Freedom to invest in individual projects and verify success or opt out, no matter the investment size: projects are financed through the purchase of "shares" that can be sold back for cash after a specified trial period, e.g., 6 months, or permanently enter an endowment for a specific site. Thus, investors have the opportunity to act on perceived project performance and success.

2. Personal connection to people and place, verifiable information on projects: Using the internet, videos made by Pacific Islanders under direction of a filmmaker, and site visits by a small number of investors (who report back to all investors), we can create a venue through which investors can develop a direct relationship with our sites and the people in them. We would offer investors a stream of

information on individual projects and opportunities to interact with coral reef owners, e.g., using video or internet conferencing technology.

3. A novel opportunity to become directly involved: At specific locations chosen by investors, we can offer an opportunity to verifiably protect coral reefs and enhance the well-being of the people who care for them while protecting a globally valued natural asset. In contrast to the passive experience of donating or adopting, we offer an opportunity to be actively involved, armed with complete consumer sovereignty- a chance to verifiably purchase human equity in the natural environment.

1. The Goal: a network of resilient coral reefs[4]

About one-third of reef-building corals face elevated extinction risk and there is uncertainty about whether coral reefs will survive the next century- evidence that, thus far, modern civilization and coral reefs have made poor companions.[5,6,7] Given anthropogenic stress on coral reefs, communities of coral reef owners across much of tropical Oceania faces four overriding challenges: 1. The effects of illicit fishing, over-exploitation, pollution, and sedimentation, 2. The uncertain effects of global climate change, 3. The need to maintain or raise living standards in the face of declining natural resources, and 4. Understanding and adapting to the synergy between these three challenges.

This prospectus outlines an approach to meet these challenges by combining the resources of coral reef owners, a global community of coral reef investors, and scientists under a decentralized network that is predicated on a shared interest in sustainable management, conservation, and persistence of coral reefs and associated habitats.[8,9,10] The approach, moreover, recognizes that there are costs associated with effective coral reef management and that synergy among all parties is maximized when costs are shared

[4] While some sites might eventually be shown to have genetic or even ecological connectivity, the network will be primarily a social one, based on human-to-human interactions.

[5] Kent E. Carpenter *et al.* One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts. www.sciencexpress.org/10 July/10.1126/science.1159196

[6] Lesser, Michael P. Coral reef bleaching and global climate change: can corals survive the next century? PNAS, March 27, 2007. Vol.104, no. 13, 5259-5260. http://www.pnas.org/cgi/content/extract/104/13/5259

[7] Knowlton, Nancy. The Future of Coral Reefs. PNAS, May 8, 2001. Vol. 98, no. 10, 5419-5425. http://www.pnas.org/cgi/content/full/98/10/5419

[8] Coral reef ownership is broadly defined to include not only communities with tenure that is formally recognized (in written law) but also communities that rely on coral reef resources for subsistence purposes, are the primary groups that physically interact with reefs on a regular basis, and, as such, are recognized as the *de facto* managers that exert the strongest localized human influence on the fate of those reefs.

[9] Coral reef investors are defined as outsiders who express their "willingness to pay" for coral reef protection and support coral reef owners by providing financial contributions, technological innovation, and scientific expertise.

[10] The approach has a conceptual foundation described in: (1) Ferraro, P.J. and A. Kiss. Direct Payments to Conserve Biodiversity. Science, 29 November, 2002. VOL 298, and (2) R. David Simpson. Conserving Biodiversity through Markets: A Better Approach. PERC Policy Series. Issue number PS-32. July 2004. http://www.perc.org/index.php

under a common strategy. It also recognizes that coral reef owners cannot be expected to make resilient commitments to long-term management that is in the interest of all three parties unless it is to their direct and measurable benefit. The Oceania Project has three main goals:

1. Protection and management of coral reefs for maximum ecological resilience,[11] and adaptation to effects of shifting climate
2. Enhanced well-being of coral reef owners by addressing their employment, health, cultural, and education needs and aspirations (and devolving project authority to coral reef owners to, for example, allow them to select social investments for this purpose)
3. Pacific-wide investigation into the climate change stress response of corals and the inherent variability in those responses, in the presence or absence of localized anthropogenic disturbances

In order to leverage the synergy described above, these project goals are explicitly linked together under a single approach: Marine Conservation Agreements (MCAs), described below.

Typical coral atoll, tropical Oceania

[11] The capacity of system to absorb stresses and continue functioning, as defined in: Simon A. Levin and Jane Lubchenco. Resilience, Robustness, and Marine Ecosystem-based Management. BioScience, January 2008/ Vol. 58 No. 1

2. The Approach: long-term marine conservation agreements

Marine conservation agreements (MCAs) are negotiated *quid pro quo* arrangements between two parties- coral reef owners and a set of investors who provide financing and technical assistance. Under the agreement, coral reef owners formally commit to reef protection, management, and monitoring. In exchange for verifiable commitments to these measures, they receive two guaranteed benefits: 1. Financing of reef management, enforcement, and monitoring, in accordance with a reef management plan, and 2. Annual contribution to a social development fund used by and under the control of the community of coral reef owners. The agreement is subject to periodic third-party audits and is ultimately financed using an endowed fund. Coral reef protection, management, and monitoring are explicitly defined, e.g., establishment and verifiable enforcement and monitoring of a network of no-take and managed marine zones. If coral reef owners breach the terms of an agreement, benefits are reduced until they return to full compliance. The parties are provided periodic opportunities (e.g., every five years) to renegotiate agreement terms[12]. Agreements can also be re-negotiated and renewed after their term expires.

MCA networks are envisioned for each of three regions of Oceania (Micronesia, Melanesia, and Polynesia), beginning with a "proof-of-concept" network in Micronesia. NaturalEquity is currently working by invitation with coral reef owners and their/our local partners in Palau and Yap to develop long-term MCAs from three existing project sites: 1. Helen Reef atoll in Palau,[13] 2. Ngulu atoll in Yap[14], and 3. The Waab Network, a cluster of projects on the main island of Yap that involves participation by six

[12] Oversight of the agreements and any re-negotiations are made with assistance of a board of agreement trustees, selected to provide equitable representation of coral reef owners, coral reef investors, and the scientific community. Any re-negotiations would be subject to a set of by-laws, a pre-determined protocol for re-negotiations, and final approval of the board of trustees.

[13] 2 degrees, 53 minutes N; 131 degrees, 47 minutes E ("Helen Reef Resources Management Program")

[14] 8 degrees, 24 minutes N; 137 degrees, 30 minutes E ("Ngulu Atoll Marine Managed Area")

communities.[15, 16] Each regional MCA network will contain a portfolio of individual conservation agreements with corresponding communities of coral reef owners.

In summary, we describe the approach as:

A. Highly direct: the agreement is a *quid pro quo* transaction- coral reef owners receive benefits in exchange for verifiable management and conservation
B. Able to meet the needs of Pacific Islanders: social investments and technology access are included in the benefits package tied to an agreement
C. Long-term: agreements are for 20 years and renewable
D. Bottom-up empowering: project control is devolved to coral reef owners, who have ultimate responsibility for management and monitoring
E. Replicable: communities of coral reef owners will demand something that demonstrably enhances their well-being and helps them protect their reefs
F. Sustainable: the approach maintains or enhances the ecological platform of the economy, culture, and heritage at our project sites
G. Performance-based: financial flows and support are contingent upon verified compliance with the agreement

A simple conceptual model: remove stressors, manage for resilience

Hard coral assemblages provide the ecological foundation for the flow of ecosystem services to both resource owners and coral reef investors who pay to protect them[17]. Our simple model calls for the application of MCAs to:

1. Reduce proximal disturbances that increase the probability that coral cover will decline or that a site will experience an ecological phase shift to a system dominated by algal communities,

[15] 9 degrees, 32 minutes N; 138 degrees, 07 minutes E ("Waab MCA network")

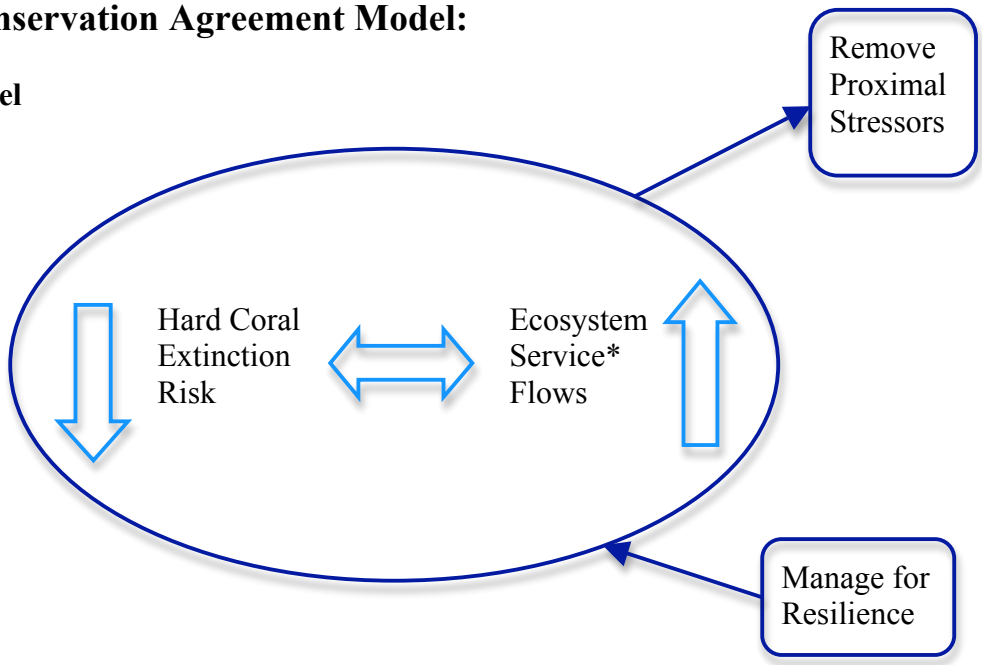
[16] Information on these existing projects is provided in separate documents. To date, each of these projects has completed or is in the process of completing biological surveys, management plans, and progress toward developing the necessary local capacity to manage, monitor, and administer projects.

[17] In the past, there has been a dichotomy of opinion over the assertion that climate-change driven loss of live coral will result, generally, in loss of fish species, reduced overall species richness and taxonomic diversity, reduced structural complexity, etc. (all of which are positively related to ecosystem service flows). There is, however, recent evidence that suggests this assertion is often valid. See: (1) Nicholas A. J Graham *et al.*, Dynamic fragility of oceanic coral reef ecosystems, PNAS, May 30, 2006, vol. 103, no. 22, 8425-8429, and (2) Geoffrey P. Jones *et al.,* Coral decline threatens fish biodiversity in marine reserves, PNAS, May 25, 2004, vol. 101, no.21, 8251-8253

2. Adaptively manage coral reefs for resilience to climate change, informed by the best available scientific information on the dynamics of coral community structure and functioning, and regular monitoring (described below), and
3. Achieve long-term, secure, verifiable investment in maintaining hard coral assemblages and the ecosystem services that flow from them.

Marine Conservation Agreement Model:

Regional Level



* "Components of nature, directly enjoyed, consumed, or used to yield human well-being". From: J. Boyd and S. Banzhaf, 2006. What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units. Resources for the Future. Washington, DC. Adapted from Oral presentation, C. LaFranchi, "Economists Hear Words of the Lagoon: coral reef conservation through long-term, equitable agreements" The International Marine Conservation Congress. May 2009.

Coral reef investors

Coral reef investors include private individuals, foundations, bi-lateral and multi-lateral donors, non-governmental organizations, and corporate entities that are willing to financially contribute to the project by providing support to MCAs in a network or portfolio.[18] All investors are entitled to receive periodic information on the status of the project, provided through audits, management and scientific reports, and site visits. A

[18] Investors can also contribute in-kind or with technological innovations and scientific expertise and data.

hallmark of the project is to appeal to investors by creating opportunities for them to directly ascertain the performance of the project with measurable and observable information that can be periodically verified by a sub-set of investors who undertake site visits and then report to all investors.

Research and Monitoring

Given the anticipated effects from climate change, research and monitoring is a necessary condition for adaptive management. Conceptually, we will focus on ecosystem recovery from disturbances, resistance to alterations, and reversibility to ecosystem changes.[19] This focus is consistent with an ecosystem-based management approach that recognizes the need to maintain ecosystem health and performance, which relate directly to productivity and yield of exploited species, in relation to both subsistence and local income-generating activities.

From a scientific viewpoint, the trend toward ecosystem-based management increases the need for data on ecosystem members. To assess the status and trends of an ecosystem, organismal data relating to four general categories are needed:

1. Presence/absence of organisms
2. Distribution of organisms, e.g., across a geographic range
3. Physiological plasticity and overall health of organisms, e.g., relating to hard coral endosymbionts, bleaching episodes, etc.
4. Genetic and ecosystem connectivity, e.g., of the site with unmanaged areas

These data can be used to understand how ecosystems respond to perturbations and how they might recover from disturbances.

A growing abundance of technologies for obtaining organismal data that have sufficient resolution and accuracy is emerging[20]; however, such methods, e.g., remote sensing,

[19] As conceptually defined in: Palumbi *et al.* Ecosystems in Action: Lessons from Marine Ecology about Recovery, Resistance, and Reversibility. BioScience, January 2008/ Vol. 58 No. 1

[20] Gretchen E. Hofmann and Steven Gaines. New Tools to Meet New Challenges: Emerging Technologies for Managing Marine Ecosystems for Resilience. BioScience. January 2008/Vol.58 No. 1/

DNA barcoding, ecogenomics, video transects, etc., require substantial financing and specialized scientific capacity, at least in some cases. Alternatives to collecting organismal data are emerging. For example, researchers are testing methods that assess the status of a coral reef using a simplified estimation of coral reef metabolism (using data on abiotic parameters).[21]

Working with other entities in the region, e.g., our existing partners such as the Palau International Coral Reef Center (PICRC), we will work toward developing a common research and monitoring framework. The ultimate goal is to develop the kind of partnerships and "infrastructure" that provide the Oceania network with the best data possible for assessing the status and trends of reefs, given budget constraints, the needs of managers and coral reef owners, and MCA requirements. Moreover, we will target a common research design and sampling protocol for the network that lends itself to investigating climate effects on large temporal and spatial scales.

Collecting data using a common research design and sampling protocol, across an entire region for the duration of an agreement, creates novel opportunities: 1. They can be used to detect climate signals of relevance to understanding the effects of global climate change and the interaction of global and local anthropogenic disturbances, 2. They provide the foundation necessary to investigations at species or molecular levels e.g., gene expression response in *Acropora spp*. to climate signals, and 3. They inform measures that can be taken by reef owners to avoid, mitigate, or adapt to the combined effects of local and global anthropogenic disturbances.

Again, at issue will be financial and capacity constraints. Moreover, there is a need to collect and use information that is legitimate from the coral reef owner perspective and that can inform peer-to-peer exchanges in the region. In response to these challenges we will:

[21] J. Silverman, Lazar B., Erez, J. 2004. Monitoring the Health of a Coral Reef Using Community Metabolism. In: Coral Health and Disease. Rosenberg E., Loya, Y. (Eds) Springer-Verlag Berlin Heidelberg New York

(i) Explore the possibility of developing a pool of ecologically and taxonomically knowledgeable data collectors ("paraecologists") recruited from communities of coral reef owners and trained to work with scientists and according to a common research design and sampling protocol[22], and

(ii) Advance the notion that scientists can be participants and benefactors in the Oceania Project, e.g., the project can offer field work support to visiting scientists (from abovementioned paraecologists) and access to a scientifically designed network of control sites, e.g., a network of no-take areas and corresponding managed areas in which the patterns of human resource exploitation are planned and monitored. Thus, we hope to create incentives for visiting scientists to employ trained resource owners to collect field data, invest grant proceeds more generally at Oceania Project sites and in Micronesia, and yield new scientific findings that directly inform management for resilience.

Socioeconomic monitoring

Measuring the efficacy of social investments and monitoring the flow of benefits from reefs is essential to the resilience of an MCA. Marine resource owners cannot be expected to make resilient commitments to long-term management that is in the interest of a global community unless it is to their direct and measurable benefit- recall that agreements are designed to reconcile conservation needs with marine resource owner needs. Socioeconomic monitoring of community well-being is essential to the reconciling of conservation and marine resource owner needs. In particular, monitoring is needed to determine if incentives and social investments are resulting in anticipated outcomes.

[22] A program is envisioned that is loosely based on the parataxonomists model developed by Daniel Janzen. In our case, "paraecologists" are likely to be the most useful input. Ideally, data are collected by a single set of "paraecologists" using a single sampling protocol. See: Janzen, D. Setting up tropical biodiversity for conservation through non-damaging use: participation by parataxonomists. Journal of Applied Ecology 2004, 41, 181-187. http://www.blackwell-synergy.com/doi/pdf/10.1111/j.1365-2664.2004.00879.x

The importance of traditional management

Pacific Island communities have longstanding relationships with their marine environments, possess ecological knowledge, and may practice traditional forms of community-based resource management.[23] At some locations in the network, scientists may need to work closely with coral reef owners to elicit and integrate traditional ecological knowledge and traditional marine resource management systems with western concepts of scientific investigation and management. In at least some cases, it may be necessary to hybridize these systems to develop management schemes that are compatible with MCAs, understanding of the differences between customary practices and contemporary conservation, able to meet community goals, and are flexible and adaptive as necessary to conserve resources.[24] Reef owners may need, for example, to adapt to ecological response patterns of coral reefs that are changing even when patterns of marine life removal by humans are not- something that may occur in response to shifting climate.

Meeting the needs of Pacific Island communities

In parts of tropical Oceania, illicit and unsustainable exploitation of valuable marine resources can cause social problems and economic loss, especially in remote and rural communities. Problems include loss of economic proceeds from marine resources, conflict over depleted resources, subsistence resource insecurity, and general degradation of natural and cultural heritage. Additional stresses due to global climate change, moreover, threaten to exacerbate these problems, especially at sites where there is a proportionally greater reliance on or competition for marine resources.

MCAs are explicitly designed to address these problems by providing three inputs, linked under one design: 1. Curtailment of illicit and/or over-exploitation of marine resources, 2. Investments in local employment, education, and healthcare (under community control

[23] Johannes, B. The renaissance of community-based marine resource management in Oceania. Annu. Rev. Ecol. Syst. 2002, 33: 317-40

[24] For additional details, see Cinner, Joshua E. and S. Aswani. Integrating customary management into marine conservation. Elsevier Ltd. 2007

and tied to sustainable management), and 3. Application of innovative technology and targeted science.

By minimizing the effects of illicit and over-exploitation of marine resources and requiring management for resilience, agreements contribute to preserving or enhancing the platform of Pacific Island local economies, culture, and heritage. Social investments provided under an agreement present opportunities for raising community living standards and well-being. Technology access and linkages to successful interventions that meet the needs of individual communities allow communities to maximize benefits from annual budgets made available for social investments under MCAs.

Of first order relevance is the absolute necessity of maintaining access by coral reef owners to marine resources consumed for traditional and subsistence purposes. In some cases, or for certain periods, existing levels of extraction for these purposes may be deemed unsustainable or in conflict with management for maximum ecological resilience. To resolve such issues, we would attempt to explicitly compensate for any necessary reduction in exploitive patterns, e.g., through provision of goods and services, employment, secure financing, etc., provided through agreements.

Working with existing networks and programs in Micronesia

We identify five over-arching programs that the Oceania Project could support or directly complement: (i) The Micronesia Challenge (MC), (ii) Palau's Protected Area Network (PAN) program, (iii) The Locally Managed Marine Area (LMMA) network, (iv) Micronesians in Island Conservation (MIC), and (v) The US Coral Reef Task Force (USCRTF).

Our overall approach with respect to these initiatives is to remain flexible and open to the notion of direct membership in these programs, formal partnership, informal collaboration, or simply sharing information. We will leave the decision whether to pursue any of these options to coral reef owners and their local partners. The Oceania Project is compatible with all of these programs, as we describe below. In fact, our

demonstration site, Helen Reef, is already a provisional member of one of these programs (the LMMA) and considering membership in a second (the PAN).

What might ultimately be gained through collaboration with the Oceania Project?

1. Sustainable financing of inputs that are presently cost-prohibitive yet necessary for effective management, e.g., a radar systems and enforcement vessels.

2. Opportunities to offset the cost to resource owners of adopting a precautionary biodiversity conservation approach (at select sites), e.g., short-term cost of dramatically reducing fishing effort and catch.

3. "Sentinel" sites that facilitate our understanding of how reefs can adapt to climate change in presence or absence of proximal anthropogenic disturbance.

4. Maintenance and protection of sites that are highly productive, resilient to climate change, and, thus, able to recover from disturbances and continuously export larvae and adult marine animals to surrounding reefs and re-seed reefs after a bleaching episode.

Micronesia Challenge (MC):

The MC is a regional inter-governmental initiative designed to facilitate more effective conservation of marine and forest resources in Micronesia. It is a commitment by member nations to conserve 30% of nearshore environments and 20% of terrestrial environments by the year 2020[25]. The Oceania Project's goal of a network of resilient coral reefs could contribute to the MC target of conserving 30% of nearshore environments.

On November 5, 2005, President of Palau Tommy E. Remengesau, Jr. called on his regional peers to join him in the MC. The members to the initiative include Republic of Palau, the Republic of the Marshall Islands, the Federated States of Micronesia, the U.S. Territory of Guam, and the Commonwealth of the Northern Mariana Islands. In November, 2008, the chief executives of the region signed an agreement formally establishing a Micronesia Challenge regional office and awarding it the full legal status necessary to operate as an official intergovernmental agency[26].

Each member country selects the best method(s) to fulfill the commitment of the MC within their respective jurisdiction. For Palau, the Protected Areas Network is the implementation body to ensure that Palau meets the MC goals.

Protected Area Network (PAN):

The PAN was passed by the Palau National Congress in November, 2003. The legislation provides a framework for Palau's national and state governments to collaborate to establish a nationwide network of terrestrial and marine protected areas with the aim of protecting the biodiversity and natural resources of value for future social, cultural, economic, and environmental stability of Palau[27]. The Oceania Project's

[25] The Micronesia Challenge. 2009. Official website: http://www.micronesiachallenge.org/

[26] The Micronesia Challenge. 2008. Government Leaders Sign Agreement Establishing Micronesia Challenge Regional Office.

[27] The Nature Conservancy. 2009. Reef Resilience Toolkit Module: Case study of Palau see: http://www.reefresilience.org/Toolkit_Coral/C8_Palau.html/

goal of addressing the opportunity cost of conservation, notably at highly diverse and productive reefs that might re-seed other areas, is complimentary of the PAN's goals.

In May 2008, former Palau President Remengesau revised and signed the PAN, establishing the PANF and the creation of a "conservation arrival fee". The PANF is a non-governmental corporation through which funds generated by the "conservation arrival fee" and the returns from the MC/PAN endowment are distributed to the PAN sites.

Partners to the PAN:

- The Nature Conservancy
- Palau Automated Land and Resources Information System (PALARIS)
- Coral Reef Research Foundation
- Palau International Coral Reef Center
- Palau Conservation Society

Locally-Managed Marine Area (LMMA) network:

The LMMA is a global learning network focused on moving toward a more locally-managed approach in which marine resources are 'co-managed' by communities and government entities. The LMMA connects practitioners (both individuals and organizations) and researchers from the network who are committed to sharing experiences and information on determining the conditions under which locally-managed marine areas can contribute to conservation.[28] The Oceania Project's approach, to develop MCAs that leave resource owners in control and build local monitoring capacity through peer-to-peer learning, supports LMMA network objectives.

[28] LMMA. 2009. http://www.lmmanetwork.org/

What is a 'Locally-Managed Marine Area'?

An LMMA is an area of nearshore waters actively being managed by local communities or resource-owning groups, or being collaboratively managed by resident communities with local government and/or partner organizations.

An LMMA strategy offers an alternate and complementary approach to the centrally-managed system where a centralized body (such as a national government agency) largely "commands-and-controls" the management of a marine area, sometimes from a remote location. However, an LMMA does not necessarily exclude national government or other institutional involvement; rather it means that the marine area in question is managed locally, perhaps with or without government aid.

An LMMA can vary widely in purpose and design; however, two aspects remain constant:

a) a well-defined or designated area, and

b) substantial involvement of communities and/or local governments in decision-making and implementation.

In 2007, LMMA members reiterated their commitment to protect biodiversity at specific sites when revising the LMMA Network objectives. Protective measures vary across LMMA sites, ranging from conservation of intact marine ecosystems to restoration of degraded areas and reduction of threats through single species restrictions[29].

Helen Reef Atoll, Palau, the demonstration site of the Oceania Project, has been a provisional member of the LMMA since 2002. It remains the only active LMMA site in Palau. An LMMA at Nahtik in Pohnpei, established in December 2003, is the only other active LMMA in Micronesia.

[29] LMMA Network 2008 Annual Report. See: http://www.lmmanetwork.org/Site_Documents/Grouped/LMMA%202008%20AR%20FINAL%2031%20July%2009.pdf

In Palau, communities need better access to peer-to-peer learning opportunities. The lack of a forum to connect sites to each other has been identified by the LMMA as a major obstacle to communities collaborating more effectively[30]. The LMMA in Pohnpei continues to face challenges from over fishing, poaching from foreign vessels, and a lack of community-based enforcement and monitoring capacity.

Micronesians in Island Conservation (MIC):

MIC is a peer-to-peer learning network designed to enhance the collaborative, organizational, technical, and political capacity of Micronesian leaders and organizations working to strengthen conservation and management of important natural areas in the region.[31] MIC members participate in biannual leadership retreats and maintain an online forum for communication.

MIC members include Palau, Guam, Northern Mariana Islands, Federated States of Micronesia (Yap, Chuuk, Pohnpei, and Kosrae), and the Marshall Islands. The Oceania Project could support the MIC peer-to-peer learning network by developing enabling conditions at its sites that allow multiple communities to share and grow the regional capacity necessary to administer, manage, and monitor, under a network of MCAs.

U.S. Coral Reef Task Force (USCRTF):

The USCRTF was established in 1998 by Presidential Executive Order 13089 to lead U.S. efforts to preserve and protect coral reef ecosystems. The USCRTF includes leaders of 12 Federal agencies, seven U.S. States, Territories, Commonwealths, and three Freely Associated States. The Task Force is responsible for overseeing implementation of the Executive Order and helps build partnerships, strategies, and support for on-the-ground action to conserve coral reefs internationally[32]. The Federated States of Micronesia and Palau are Freely Associated States to the USCRTF.

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[30] *Id.*

[31] Micronesians in Island Conservation. 2009. http://mic-network.blogspot.com/

[32] U.S. Coral Reef Task Force. 2009. http://coralreef.gov/

The Oceania Project's leveraging of the international willingness-to-financially-contribute toward coral reef conservation supports the USCRTF goal of building partnerships to conserve corals internationally. Moreover, the Task Force's efforts to support conservation on-the-ground can be complimented by the Oceania Project's emphasis of working through local partners in Micronesia.

The Oceania Project

In summary, the Oceania Project could support these regional programs in various ways, depending on the specific program:

1. By providing enhanced and secure financing (e.g., through international partnerships, to address the opportunity cost of conservation),
2. Building local capacity to manage, administer, and monitor,
3. Enhancing peer-to-peer learning networks and,
4. Using of targeted science and technology.

MCAs could allow members of the abovementioned initiatives to partner with outside investors who share their goals. An MCA could, for example, complement an LMMA member by augmenting financial resources required for surveillance and enforcement and contributing to development of management capacity (such an effort could enhance the capacity of the LMMA to achieve a stated objective- 'protect biodiversity at specific sites')[33]. The MIC learning network, for example, could be enhanced by the provision of technological inputs through an MCA, e.g., use of the internet to share information and experience, and use of acoustic data collection equipment. Moreover, an MCA could, in some cases, allow communities the option of reducing local dependency on consumptive use of marine resources through alternative livelihood opportunities, creating greater opportunities for recovery of depleted stocks and ecological resilience.

[33] LMMA Network 2008 Annual Report. See: http://www.lmmanetwork.org/Site_Documents/Grouped/LMMA%202008%20AR%20FINAL%2031%20July%2009.pdf

3. The Strategy: an MCA network in Micronesia that goes to scale

We will develop a proof-of-concept network of three MCAs in Micronesia that is poised to go to scale. Replication and scaling will critically depend on the demand from individual communities of coral reef owners to see their reefs protected and well-being enhanced by an approach that gives them control, makes them accountable to performance, provides access to the best available technology, and guarantees the availability of long-term financing. Under such conditions, coral reef-owning communities can demonstrate the benefits of this approach to other communities who may then decide to participate in similar agreements (e.g., through peer-to-peer learning).

Potential for growth: MCA process driven by demand from coral reef owners
Growth is driven by the benefits received individually by each party, e.g., financing of enforcement and management, community development for coral reef owners, enhanced opportunities for scientific investigation for scientists, resilient, measurable, and cost-effective conservation for coral reef investors. These benefits flow from the synergistic combination of resources of all three parties that is made possible by the MCA model. The cornerstone of this project is the enduring demand for agreements from satisfied coral reef owning communities. Lasting community support and willing participation by coral reef owners is a necessary condition for success. This condition justifies the strategy for financial sustainability that anchors long-term commitments of twenty years or more to endowed funds. Measurable project outcomes can then be audited by a third party system, to ensure compliance.

Successful implementation of conservation agreements hinges on three key elements: 1. The capacity of coral reef owners to effectively manage their projects, monitor their reefs, and foster equitable community representation and benefits sharing (from social investments that flow from an agreement), 2. Social investments that meet or exceed expectations, and 3. Secure financing for a period of 20 years or more.

Strategy for site selection and network expansion (scaling)

Oceania's coral reefs are undergoing increasingly significant ecological alterations from local and global anthropogenic disturbances. Even if localized anthropogenic stressors are minimized, the effects of global climate change (e.g., rising sea surface temperatures and sea levels, ocean acidification, and concurrent spread of pathogenic disease) will continue to precipitate ecological change in coming decades (even when proximal stressors are eliminated). Furthermore, the severity and distribution over time and space of such changes will be difficult to predict and monitor. Because the effects of shifting climate on corals are potentially severe and uncertain, management for ecological resilience across a diverse set of sites, informed by targeted science, is now a necessary condition for successful conservation of coral reef ecosystems in Oceania.

Our strategy is to select project sites in the Pacific Region that offer the best prospects for long-term commitment from coral reef owners, ecological resilience, opportunity costs of conservation[34] that are acceptable to investors, and that offer a broad range of human dependence and biophysical conditions.

We will first inventory reefs associated with oceanic islands in the Pacific using available remote sensed data[35] and prioritize areas where corals do not have an elevated extinction risk.[36] Through this step, we will identify an inventory of candidate sites. In defining the inventory of candidate sites, we will also draw from other inventories of high priority sites, e.g., priority sites defined by The Critical Ecosystem Partnership Fund (CEPF) and the Nature Conservancy (TNC).

We will then further refine the list, over time, by targeting areas that generally adhere to the following criteria:

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[34] The sum of all that is given up in order to achieve desired conservation outcomes, e.g., costs of lower rates of consumptive extraction, adequate surveillance and enforcement, and scientific monitoring and adaptive management.

[35] The Millennium Coral Reef Mapping Project: Understanding, Classifying and Mapping Coral Reef Structures Worldwide Using High Resolution Remote Sensing Spaceborne Images: http://www.imars.usf.edu/MC/index.html

[36] Kent E. Carpenter *et al.* One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts. www.sciencexpress.org/10 July/10.1126/science.1159196

1. A well-defined community of legally or informally recognized coral reef owners who have formally expressed interest in an MCA
2. Opportunity costs of conservation that are conceivably acceptable to investors
3. Human exploitative and behavioral patterns that do not present insurmountable challenges to efforts that would reduce or remove proximal stressors and management for resilience
4. Taxonomic diversity, perceived productivity, and prospects for ecological resilience that are equal to or better than perceived "averages" for the region or sub-region
5. Good prospects for cost-effectively eliminating illicit exploitation of marine resources, if such conditions exist
6. Manageable impacts from land-based pollution and anthropogenic sedimentation
7. Absence of political or social opposition to the MCA approach

Finally, we will target a diversity of sites across a spectral range of human dependence, biophysical, and oceanographic conditions. We define a spectrum that is bounded by two generalized site types:

Type 1: Spatially large, self-seeding, relatively undisturbed reefs with low human dependence ("climate change precautionary sites")	**Type 2: Spatially small, *non*-self-seeding, with pronounced anthropogenic pressure and dependence ("human dependence sites")**
Safe bets, precautionary value, recognition that ALL reefs are threatened ultimately by climate change	Threatened, yet biologically rich and ecologically productive sites with high value and significance to people
Modest proximal threats that can be brought under control with relative certainty	Robust prospects for recovery of depleted species, strengthened ecological functionality
Expansive, contiguous reef areas (>10 km2 area)	Spatially small reefs and/or patches (<10 km2 area)
Relatively low subsistence dependence	Moderate or relatively high subsistence dependence
Self-seeding in terms of larval dispersal and recovery from episodes of coral bleaching; limited connectivity with other reefs	Non-self-seeding, but likely to have ecological connectivity with other similar reefs and be key to re-seeding other patch reefs with high human dependence
Good prospects for facile MCA demonstration, catalytic effects in the region and with coral reef investors	Sites that are likely to be of increasing importance in the event that people from remote locations migrate toward population centers, e.g., outer islanders migrating to Yap Island

Existing sites at Helen Reef Atoll in Palau and Ngulu Atoll in Yap fall into Type 1 generalized category, Waab and similar sites on Yap Island fall into Type 2 category. Thus, our proof of concept network will contain an array of both types.

Anticipated scale

After a preliminary review of reefs in Micronesia, we conclude that there are at least 70 "high conservation value" coral reef complexes (atolls, low-lying and high islands). This is our initial total site inventory and conservation target. As a preliminary goal we assert that protecting 25-30% of these sites may be sufficient to ensure the existence of a "critical mass" of resilient reefs in the Micronesia bioregion (required to prevent massive phase shift to different habitat types). Thus, we see a need to invest in the protection of about 20 of the 70 sites identified.

Coral reef owning communities will protect some of these sites already, given available resources and sustained actions based on their self-interest alone, and work done in collaboration with other partners. As an initial and precautionary estimate of need, we assert that the Oceania Project will need to protect at least 15 sites (of the twenty sites we identified above) to reach the abovementioned 25-30% minimum protection threshold. Thus, we think that at scale the Oceania Project network will consist of about 15 MCAs of size and ecological health that is roughly comparable to MCAs at our proof of concept sites (Helen Reef, Ngulu Atoll, and the Waab network on Yap). Further analysis will be needed to refine these estimates and develop a scientific basis for optimal network size and spatial configuration (to take advantage of larval connectivity, optimal size and spacing of MPAs, etc.)

Overcoming logistical constraints

Logistical constraints present challenges: 1. Scarce local capacity to manage agreements, provide adequate enforcement, and monitor reefs, and 2. The need for communication, surveillance, and travel across long distances, between remote islands and atolls. Use of Internet technology, video conferencing, and acoustic sensors (that collect data that can be used to monitor vessel traffic and ecological events) can greatly reduce these challenges and the cost of communicating and sharing information over vast distances in remote areas. These technologies can be used to enhance area surveillance (e.g., to detect illicit fishing), support peer-to-peer learning throughout a social network of development

projects, and build/share capacity to manage and monitor projects[37]. See appendix B for additional information on use of acoustic technology.

These technologies could be deployed both as stationary elements and on a relatively inexpensive mobile platform, e.g., auxiliary sailing catamaran that services all sites in a social network. A mobile platform could also support community programs and meetings, youth and community exchange programs, and dive and ROV operations needed for biological, ecological, and socioeconomic monitoring. Moreover, use of these technologies can reduce the frequency of airline travel and the overall carbon footprint of the projects.

[37] For an example of how the Internet is being used to overcome logistical and information constraints, see a summary document by One Global Economy, http://www.ogecorp.com/OGE-One-Page-Summary.pdf

4. Financing marine conservation agreements

MCAs require financing in two areas: 1. One-time funds to design and initiate agreements, and 2. An annual budget after an agreement is initiated, to cover the cost of management, enforcement, monitoring, and social investments. For several reasons, financing annual budgets is best achieved with a fiduciary trust or endowed fund:

1. A key incentive provided by an agreement is the long term "guarantee" that is in part afforded by the use of a trust- coral reef owners can know that dedicated financing is available as long as the terms of an agreement are met
2. Such dedicated funds serve as a powerful signal to coral reef owners by investors that a meaningful commitment is being made. Evidence of such a commitment serves as a cornerstone of the overall long-term commitment by a set of united partners that is required to successfully protect and manage reefs.
3. Such funds can also be used by a community to leverage additional financial support, especially in cases where the community has demonstrated local capacity and expertise to manage and administer projects
4. With few exceptions, there are generally poor prospects for economic development over the next 25 years of the type that would render the endowment superfluous, in view of the small size and remote locations of most places targeted by this project.
5. Perpetual fundraising comes at a cost: time allocated to fundraising is a resource that could have been used in project implementation; meeting donor mission alignment requirements can make it difficult to maintain focus on a successful approach

Below, we outline our 2-part strategy for financing these two areas.

Part 1: Using foundation funds to design and initiate agreements

The first part of the financial strategy is to seek additional grants from foundations to complete the design of agreements, starting with an agreement for the Helen Reef Project. In the case of Helen Reef, funds are needed to maintain ongoing enforcement,

management, and monitoring. To initiate an agreement, additional funds are needed to work with coral reef owners and government to design the agreement and establish local capacity required to administer the enforcement, management, monitoring, and social investments that will occur under an agreement.

We will work from a longstanding precedent: grants from foundations have already been used to successfully develop coral reef management and conservation projects, including the creation of the Helen Reef Project. At Helen Reef and for similar projects, these funds have typically been used to support:

1. Biological surveys of coral reefs
2. Legal designation of protected or managed areas, e.g., marine zones
3. Development of enforcement capacity and required infrastructure, e.g., radar equipment, boats, and deputized ranger teams
4. Design and implementation of a management plan
5. Organization and development of community-based outreach and action

Successful efforts in these areas create the necessary foundation from which an agreement can be developed with a willing community of coral reef owners. That the Helen Reef Project in Palau is such a case serves as the primary rationale for selecting it as first priority for a proof-of-concept agreement. Moreover, the Helen Reef project has established a memorandum of understanding (MOU) with a project on Ngulu atoll in Yap, and is thus well positioned to support replication and initiate the creation of a network in Micronesia.[38]

[38] The Yap Community Action Program, "building environmentally friendly communities" (Charles L. Chieng, Executive Director).

Part 2: Capitalizing a fiduciary trust through channeling the international willingness-to-financially-contribute to coral reef conservation

Capitalizing endowment funds is not a common mode of investment by the philanthropic donor community (i.e., foundations, multi and bi-lateral donors, corporate and private philanthropists). Moreover, the cost of capitalizing funds necessary to finance the project at full scale may ultimately exceed the level of funds that could be raised from philanthropic entities with a record of financing coral reef projects in Oceania, under even the most optimistic and cost-effective possible outcome. Therefore, we propose to iteratively develop a public/private consortium of coral reef investors.

First, we conceive of the set of coral reefs in Oceania as globally valued natural asset that is undergoing increasingly significant ecological alterations from local and global anthropogenic disturbances. We recognize that even if localized anthropogenic stressors are reduced to minimal levels, the effects of global climate change, e.g., rising sea surface temperatures and sea levels, ocean acidification, and concurrent spread of pathogenic disease, will continue to result in ecological changes over a decadal timeframe. Furthermore, the severity and distribution over time and space of such changes will be difficult to predict and monitor.

Second, we see the need to aim for a network size that is consistent with the scope and scale of the effects of abovementioned stressors, recognizing that at present it is difficult to robustly estimate the minimum network size and ecological connectivity requirements that would virtually ensure that an ecologically functional set of reefs containing a diverse assemblage of hard corals will persist in Oceania over the next 25-50 years. Third, we note that while we have some cost data for our initial projects, and that these projects are likely to be cost-effective compared to alternatives,[39] we cannot yet robustly estimate the cost of a network at scale. Finally, we note that the trust fund financing model we develop will need to be adapted over time, in view of fundraising success and

[39] Conservation incentive agreements- the proposed approach- is considered a 'direct' payment approach to biodiversity conservation investments, in contrast to 'indirect' approaches. See Ferraro, Paul, J. and A. Kiss. Direct Payments to Conserve Biodiversity. Science. 29 November, 2002. VOL 298

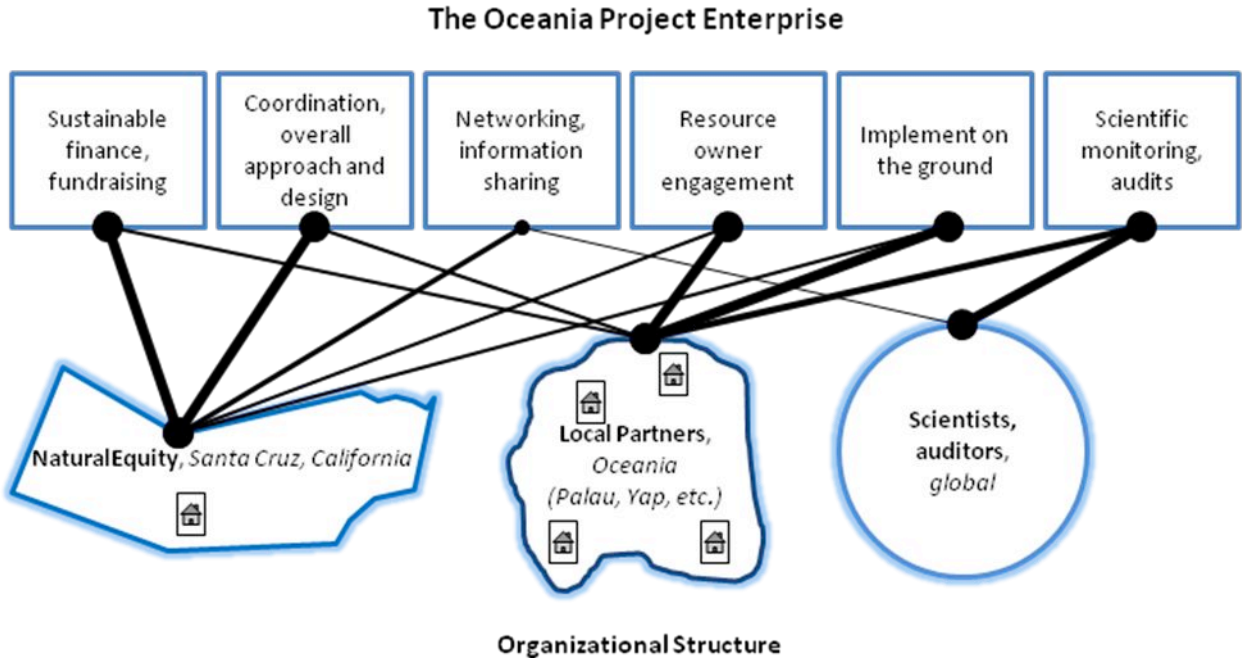
costs, increasingly accurate information on unit costs, and ultimate network size and configuration requirements.

5. A decentralized enterprise to serve the network

We envision an enterprise that consists of NaturalEquity, our local partners in the Oceania region (e.g., the Yap Community Action Program, Hatohobei Women's Association, and Palau International Coral Reef Center), and a small group of social and biological scientists and professional auditors. As a general rule, we seek to maximize the flow of resources to local partners and resource owners and minimize the high-cost of international staff and related travel and overhead costs.

We will develop an enterprise that maximizes control and autonomy by region-based entities while cost-effectively delivering key aspects of our approach:

1. The removal of proximal anthropogenic disturbances (e.g., illicit fishing, over-exploitation, adverse terrestrial disturbances) through incentives,
2. Social investments provided in a partnership setting that meet the needs of coral reef owners (e.g., direct employment and access to technology provided by an MCA) and,
3. Scientific research and monitoring for adaptive management and acclimatization by hard coral assemblages, resulting in sustained or enhanced ecosystem services.



Oceania Project Enterprise:

1. NaturalEquity, Santa Cruz, CA
    a. Founder
    b. Program managers
    c. Research and monitoring coordinator
    d. Support staff
    e. Contracted scientists and legal/financial/technical assistance
2. Local Partners in Palau and Yap
    a. Local managers and executive directors
    b. Community engagement teams
    c. Regional monitoring team ("paraecologists")
3. International Scientists, other partners
    a. Coral reef biologists/ecologists
    b. Social scientist (socioeconomic monitoring expert)
    c. Third party project auditors

Building the NaturalEquity enterprise

By December 2010, we anticipate having three MCAs, constituting the 'proof of concept' Micronesia MCA network, fully designed, vetted by resources owners, and ready to be financed.

At that time, having fulfilled the objectives of a Catalyst Grant from the Mulago Foundation, NaturalEquity will be well eligible to become a grantee of the Mulago Foundation's Scalable Investments Portfolio, which awards larger grants over multiple years to small enterprises with a focus on scalable social capital development.

6. Funding needs: toward a "proof-of-concept" in Micronesia

For the first phase of the project, financial support is needed in three areas.

1. **Develop first three agreements in Micronesia (MCA network 'proof-of-concept')- partial funding provided by the Mulago Foundation, seeking additional funds**
    a. On-going management, enforcement, monitoring, and community outreach at primary sites in Palau and Yap
    b. Conduct community engagement and general scoping of potential third project site on high islands of Yap and Palau
    c. Design and initiate 20-year agreements
    d. Identify 10 or more high priority "candidate" sites for network expansion

2. **Implement first iteration (pilot) of a coral reef investor model- seeking funds**
    a. See Appendix A for details

3. **Develop a common monitoring program and Micronesia-based team of ecological and socioeconomic data collectors- - funding for the demonstration site at Helen Reef, Palau is being provided by the NOAA Coral Reef Conservation Program[40], additional funds being sought to scale the program.**

[40] For details see: http://www.naturalequity.com/images/HRRMP_Monitoring_Framework_NOAA_CORAL.pdf

Appendix A

A coral reef investor model

Again, we recognize that capitalizing trusts is not a common investment mode for public entities, the prospects for self-financing conservation activities at our project sites are poor over the next 25 years, and financing from "proven" sources may ultimately fall short of what is needed. Hence the need for a model that leverages financing from some portion of the private global community to protect and manage a globally valued asset.

To begin an iterative process toward a solution, we provide an illustrative and innovative model for uniting a community of private coral reef investors, "Coral Reefs Online". We forward the notion of not simply asking people to give to a good cause, but attempting to appeal to specific human wants and needs, and thus provide a demanded good or service in exchange for investor support.[41] We introduce a concept for uniting and leveraging a global community of coral reef investors. Recognizing that this would be a highly competitive endeavor, we aim to provide investors with a novel experience worth paying for:

1. Freedom to invest in individual projects and verify success or opt out, no matter the investment size: projects are financed through the purchase of "shares" that can be sold back for cash after specified trial period, e.g., one year, or permanently enter a fiduciary trust. Thus, investors have the opportunity to act on perceived project success.
2. Personal connection to people and place, verifiable information on projects: Using the Internet, videos made by Pacific Islanders under direction of a filmmaker, and site visits by a small number of investors (who report back to all investors), we can create a venue through which investors can develop a direct relationship with individual places and the people in them. We would offer investors a stream of

[41] Raising funds for conservation from private entities is a competitive endeavor. Large, well capitalized and publicly branded organizations seek similar funds and have devised marketing schemes that offer 'adopt and acre' and similar programs. Any approach we devise will almost certainly fail unless it can make a novel appeal to something people want and cannot find elsewhere for less.

information on individual projects and opportunities to interact virtually with coral reef owners.

3. A novel opportunity to become directly involved: At specific locations chosen by investors, we can offer an opportunity to verifiably protect coral reefs and enhance the well-being of the people who care for them, while protecting an important global ecosystem. In contrast to the passive experience of donating to a large NGO or adopting an acre, we offer an opportunity to be actively involved, armed with complete consumer sovereignty- a chance to verifiably purchase human equity in the natural environment.

Funds capitalize a trust through several modes:

1. Conventional philanthropic giving (tax deductible)- funds permanently enter the trust, e.g., from the consortium of public investors
2. Purchase of project "shares" in individual projects, which cannot be sold back during an initial period, e.g., first six months. At the end of the period, the investor is given the option to receive money back (sell shares), or allow the funds to permanently enter the trust, perhaps induced by an offer to see the value matched. Again, shares cannot be sold except according intervals specified under the program, as stated above.
3. A small portion of gross sales or profits donated by a business, e.g., Oceanic, US Divers, Aggressor Fleet, Billabong, similar to Patagonia's One Percent for the Planet approach. Some businesses could use this program to enhance the marketing of products. For example, dive manufacturers can claim that a purchase of their product contributes directly to protection of coral reefs in Helen Reef atoll or Yap Island, a popular diving destination. Such investments could also be fashioned as biodiversity offsets.
4. Funds that match the purchase of shares for any of the above from public entities and scientists, etc. who benefit from a successful network of projects

Options 3. and 4. above can capitalize the trust either as philanthropic donations or through the purchase of shares.

Coral Reefs Online

Piloting a self-financing capitalization and outreach model focused on divers

Summary: Developing an online outreach and investment forum

We will (i) provide divers with a novel way to invest online in the protection of individual coral reefs and verify that reefs at selected projects are being protected- or their money back, and, (ii) engage the global diving community in the process of scientifically informing climate change policy for the benefit of reefs, using data from our portfolio of project sites.

Novel aspects of the capitalization model:

1. A money back guarantee: funds are returned at the end of year 1 if a diver is not satisfied with project performance (and used to capitalize a fiduciary trust if not returned)
2. Freedom to select individual projects: investors select reefs/projects based on their preferences
3. Performance verification: two investors randomly selected for bi-annual site visits report back on to the investor community; participating projects are required to make project information available online
4. A way to give back: divers can verifiably contribute to stewardship of reefs in the regions they have visited or want to visit for diving

Model Description

Coral reefs in Oceania are globally valued natural assets that are undergoing increasingly significant ecological alterations from local and global anthropogenic disturbances. Even if localized anthropogenic disturbances are minimized, the effects of global climate change, e.g., rising sea surface temperatures and sea levels, ocean acidification, and concurrent spread of pathogenic disease, will continue to ecologically stress reefs over a decadal timeframe. Healthy reefs will likely adapt to climate change while stressed reefs are at risk of irreversible deterioration.

At the local level, coral reef owners face manageable challenges from the effects of poaching, over-exploitation, land-based pollution, and climate change. Through long-term, formal partnerships with coral reef owners (MCAs), NaturalEquity is securely and cost-effectively protecting reefs in Oceania from poaching, over-exploitation, and land-based pollution, and managing healthy reefs for maximum ecological resilience to climate change. Partnerships are critical given that coral reef owners are increasingly unable to protect their reefs working alone, often in isolation, and with minimal assistance from government.

There is a duel need to finance these partnerships and inform climate change policies. In particular, there is a need to finance the cost of surveillance and enforcement, monitoring, and establishment of marine protected areas (which sometimes also necessitate alternative economic activities to directly offset a reduction in fishing effort by reef owners).

We will meet these needs by creating a social media program that is focused initially on divers. We see divers as the best initial target audience for the model given their direct knowledge of reefs gained through firsthand experience.

In the US, Japan, and Europe, there are more than 5 million certified divers, most of whom can be engaged using an online format. We will leverage the internet, our existing projects, and input from marketing and web experts to achieve two overall goals:

I. Channel international willingness to financially contribute to reef protection and acclimatization, using an online format that allows divers to buy shares in individual projects, develop relationships with sites they select, e.g., in Palau and Yap, and the people who manage reefs at those places, and verify performance with scientific data;
II. Raise awareness and facilitate policy action, e.g., using scientifically informed arguments, regarding probable effects of climate change on reefs, using data and experience from a growing portfolio of partnership sites in Oceania

Coral reefs and Pacific Islanders are on the frontline of global climate change and marine pollution. From our projects come compelling stories that communicate the direct connection between our carbon emissions and the health and well-being of one of the ocean's most biologically diverse and charismatic ecosystems and the people who act as its stewards. With these stories, we can capture attention while communicating basic information on sea surface temperature warming, sea level rise, acidification, and spread of pathogenic disease in hard coral species. Moreover, our project sites host nesting colonies of marine turtles, terns and boobies and so can illustrate the problem of marine debris in the ocean.

Policy engagement themes:

1. Global climate change in the ocean, communicated using scientific findings and stories from marine conservation and management projects in Oceania
2. The need to take direct, cost-effective action through secure partnerships
3. How measures that reduce our carbon footprint and plastics in the ocean have a measurable effect on marine life and people in Oceania

Implementation

i. Engage and define participating projects in Oceania, e.g., Helen Reef and Ngulu Atoll projects, in terms of annual costs, threats, profile of coral reef resources and related, spatial area, shares offered, etc. (output: prospectus for each project in a portfolio)

ii. Engage marketing and web-hosting subcontractors to support development of ad campaigns and web platform, e.g., www.amarketingdesign.com

iii. Engage diving clubs and associations to seek permission to communicate with members (e.g., PADI, NAUI, PADI Foundation, DAN network)

iv. Implement ad and marketing campaign that targets active/online divers

v. Establish the basic legal and institutional arrangements necessary to pilot an initial coral reef outreach and investment effort for three years.

Financial targets

From a pool of about 100,000 contactable divers in the US, Japan and Europe, we will ultimately recruit 2,000 divers annually to contribute an average of $120 per diver per year (see year 3 in Table 1 below). Net revenue flows will capitalize a fiduciary trust.

Table 1
Financial Model Development, Minimum Goals

	Contributors (number of divers)	Average annual contribution ($)	Gross ($)	Estimated costs ($), implementation	Net ($)
Year 1	500	60.00	30,000.00	100,000.00	(70,000.00)
Year 2	1000	90.00	90,000.00	50,000.00	40,000.00
Year 3	2000	120.00	240,000.00	50,000.00	190,000.00
		Sub totals:	360,000.00	200,000.00	160,000.00

Ad Mock-up (draft for illustrative purposes only)


Think climate change won't affect your diving? Think again!

Take coral reefs. Even a small climate-induced rise in ocean temperature can cause reefs to bleach and die on a massive scale. The scientific evidence is clear: healthy reefs will adapt to climate change much better than reefs affected by over-fishing, pollution, and sedimentation. Still not convinced? See:
http://www.naturalequity.com/thechallenge.html

Too precious to lose: divers get it!

No one understands the value of healthy coral reefs better than divers do. That's why we're giving you the opportunity to deliver a healthy reef that can successfully adapt to climate change- or your money back!

Divers can deliver healthy coral reefs. Be one of them!

We have the tools to directly intervene, NOW.

Each pre-assessed coral reef community is working verifiably to protect reefs from illegal fishing and land-based pollution. All they need is a partner [you] to invest with them.


Coral reef owners


Reefs they protect


[YOU]

Appendix B

Marine acoustic technology primer

Passive Acoustic Monitoring Primer for Marine Resource Managers
Updated March 2007

Definition:

Underwater passive acoustic monitoring involves the use of submerged sound recording devices (hydrophones) to monitor noises that are produced by biological or human activities. It is different from active acoustic monitoring which records noises produced by tags that researchers implant in species.

Potential Measurements:

1. Vessel Engine Noise – presence of vessels in restricted areas, size of engine
2. Fish and Cetacean Calls – sounds associated with behaviors such as spawning
3. Ambient Reef Noises – indicator species noises such as snapping shrimp
4. Dynamite Fishing – frequency and location of explosions

Advantages of this Technology:

1. Signal is not dependant on light level and can be monitored at night more easily than visual methods
2. Biofouling (growth on instrument from algae, barnacles, etc) is minimal compared to optical instruments allowing longer undisturbed deployments
3. Can pick up species that are easily missed through visual methods such as cryptic coral reef species, deepwater fish, and marine mammals
4. If used for vessel monitoring, it can decrease the cost of personnel and fuel and increase safety of enforcement officers by minimizing time in harsh environments

Limitations and Challenges:

1. While vessel noise and the noises produced by a few select species are well understood, correlations of other sounds to ecological events need further scientific investigation. The ability to monitor for reef health is still in development.
2. Signal processing is too complex for most marine management operations and will require contracting and partnerships with academic institutions and/or private companies.

Sampling Design and Cost:

Hardware cost per instrument ranges from $300-$20,000. You will need an array of hydrophones to cover your area, the density of instrumentation depends on what you are measuring (the level and frequency), the level of background noise, and environmental parameters including salinity, bathymetry, sediment type and wind speed. A typical detection range is 0.5 to 10 nautical miles.

In addition to the hardware costs, deployment, recovery, and analysis costs must be considered. Several options exist depending on staff capacity and how rapidly you need the data, and some of these options are presented below.

Option 1. Deploy and analyze with your staff. You must consider personnel, deployment vessel, and maintenance costs. Software will cost several thousand dollars. Training for staff is an undetermined cost. Recovery and analysis is on your own time-frame.

Option 2. If you want real-time data, the hydrophones can be connected to radio, cellular, or satellite networks. Cellular networks are available in urban areas. Radio networks are available within 30 nautical miles of populated areas. Satellite networks are available for more remote locations. Service costs depend on the amount, type, and frequency of data transmission and remoteness of location. One low-cost satellite option is a low-bandwidth service like Iridium which provides global coverage, hardware costs are below $1000,

and service costs are on the order of $1 per minute. Data analysis costs still need consideration if you are transmitting more than a presence/absence binary signal.

Option 3. Contract to a third party to provide the hardware, deploy the instrument, and analyze/interpret data for you on a regular time period (for example, 6 months). The cost will vary depending on your partnership, but as an example, one organization is offering leased hardware, deployment, and analysis at a rate of $8,000 to $15,000 per site.

Summary and Recommendations:

Passive acoustic monitoring can be used immediately for vessel detection and at this time will be most successful in focusing enforcement of poaching in remote marine managed areas. Cetacean monitoring is also an immediate possibility. As more instruments are deployed and as the science develops, these instruments may be used for reef health monitoring in the future. If capacity in-house is limited, it is recommended that managers partner with scientists and/or private companies to analyze and interpret the data collected from hydrophones.

For More Information, Explore the Alliance for Coastal Technologies Website

www.ACT-US.info