



## *The How and Whys of Socio Economic Assessments*

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### Statement of Issue

INCREASING emphasis has been placed on the human dimension of coral reef management as managers recognize the importance of understanding the people who use and depend on coral reefs. As a result there has been growing interest in incorporating the *social* sciences into reef management. Socioeconomic assessments provide a starting point for incorporating these fields of science into the design of more operational and acceptable management plans by providing insight into the cultural, social and economic background of various stakeholder groups. Yet, there is a lack of knowledge of how to conduct these assessments and why they are useful to reef management programs.

Scientists and managers at the 9<sup>th</sup> ICERS discussed alternative methods for conducting socioeconomic assessments and the importance of the results for reef management programs. The session speakers presented a variety of approaches for conducting socioeconomic assessments ranging from more structured, quantitative approaches to more participatory, interactive and qualitative methods.

### State of Knowledge

#### *Short-term Socioeconomic Assessment*

One of the most straightforward approaches to conducting socioeconomic assessments is a short-term socioeconomic assessment involving observations of user-group activities, focus groups with key informants, and semi-structured surveys. The assessment can be used to develop a sketch of the short-term and long-term social and economic impacts of a marine system on user groups or to determine demographic characteristics, such as population growth rates, education levels and migrant ratios. In addition, data can be used for econometric analysis (regression) to determine relationships between variables (for example, catch is positively related to whether the fishermen in the household make daily trips).



Photo: Coastal Resources Center, URI

**The human dimension is a critical aspect of effective and sustainable coral reef management, which socio-economic assessments help address**

The socioeconomic assessment is only the first step toward a larger participatory management process.

#### *Use of Multivariate Analysis*

Several presentations detailed the analyses used to understand stakeholders and reef uses, particularly focusing on multicriteria analysis. Multivariate analysis was used to identify the variables responsible for the success of marine sanctuaries. Using this approach, data was collected on select variables allegedly impacting community based marine sanctuary success. Similarly, multicriteria analysis was used to investigate the relationships between ecological indicators (living coral cover, number of commercial species seen per dive and underwater visibility), social indicators (number of fishermen, number of tourists), and economic indicators (fisherman individual profits, profits from dive operations).

#### *Town Resource Cluster Analysis*

Town Resource Cluster Analysis (TRC-Analysis) was presented as a framework for describing and examining the

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relationship and inter-dependencies between resource systems and social systems. The analysis involves identifying town clusters of coastal communities associated with primary and secondary fisheries resource catchments and using this information to determine the location and type of social impacts associated with the fishing industry and management regimes. Trade off analysis, a combination of stakeholder analysis (identification of stakeholders and their interests) and multi-criteria analysis (development of management criteria, evaluation of alternative management scenarios), draws on participatory approaches and consensus building to bring together diverse options through shared discussions of priority issues. This approach enables decision-makers to gain an understanding of stakeholders' preferences for different management options and their consequences on stakeholders.

#### *Who to Study*

An important aspect of conducting socio-economic assessments is determining *who* to study. Studies often target the easily-defined groups of people, such as local residents, subsistence or commercial fishers, or dive tourists. When defining whose values are to be considered, socio-economic assessments for natural resources follow the thin line between being too specific about the user groups (and thereby not counting valid "holders of value") and being too global (and thereby running the risk of an invalid, overly-general result).

#### *Utility of Socio-economic Assessments*

The utility of socioeconomic assessments, both from the *results* of socioeconomic assessments as well as the *process* of collecting the data was discussed. Information can assist reef managers in formulating appropriate plans for reef management. For example, data collected on the sociocultural, economic and political aspects of community based marine sanctuaries were used to determine the variables associated with the success of marine sanctuaries (population size, a perceived crisis, successful alternative income projects, relatively high level of community participation, continuing advice from the implementing organization and inputs from the municipal government). This information is useful not only for the managers at the studied sites, but others considering establishing marine sanctuaries. Similarly, the results from a socioeconomic assessment were used to determine the social and economic impacts of reserves in the Florida Keys National Marine Sanctuary, such as dive/snorkel operators have experienced a slightly positive economic impact and a negative social impact in the form of increased crowding

inside reserves since reserve establishment. A socioeconomic analysis was used to recommend policies for local marine management, specifically the need for restrictions to protect local fishermen's rights to fishing grounds and the need for greater links between agriculture and fisheries policies. The identification of social and resource systems, specifically town clusters, was used to determine the social impacts of the fishing industry and management regimes, facilitate more directed community involvement programs, and provide basic information on community stability, social resilience, sensitivity to change, community well being and social capital. The results of multicriteria analysis assist in decision making and reaching consensus between the community of users, researchers, ecologists and managers. Multicriteria was used to assess conflicting preferences and in the process stimulate communication among stakeholders.

#### *Value of the Process*

In addition to the value of the results of a socioeconomic assessment, the actual *process* of conducting the socioeconomic assessment can assist managers, particularly in establishing a foundation for participatory projects. Participatory approaches to conducting socioeconomic assessments can help reef managers both to collect the socioeconomic information and establish productive and pro-active relationships with the stakeholders. This can help to build a common understanding of management issues among stakeholders and to identify commonly agreed management objectives. It can also help establish greater commitment to reef management plans that reflect these common objectives. Socioeconomic information can assist in incorporating stakeholders into decision-making, including planning projects. The value of the process of conducting trade-off analysis not only led to a consensus on a decision, it also provided opportunities for trust building, consensus building, empowerment and knowledge dissemination.

### **Relevant Actions Being Taken to Address the Issue: Case Studies**

The case studies highlighted in the presentations illustrated the value of socioeconomic assessments to reef management. A socioeconomic assessment to identify the short and long-term socioeconomic impacts of the Florida Keys National Marine Sanctuary reserve system on consumptive and non-consumptive marine user groups in Key West has proven useful for subsequent management of the FKNMS. Multivariate analysis identified the key factors affecting success of marine sanctuaries in the



Fish and prawn farming in Indonesia

Photo: Coastal Resources Center, URI

Philippines, which is useful to managers both in the Philippines and other managers considering establishing marine sanctuaries.

Socioeconomic data can serve as the foundation for a participatory project design workshop, which in turn can be used to produce a vision for managing an area. Trade-off analysis has helped to establish a stakeholder group

which continues to lobby government, participate in the decision-making process, and pursue co-management arrangements. Socioeconomic assessment was useful in determining future management strategies for a local area based on the findings that migration is the major driver of human population growth in the area and that migrant households are heavily dependent on fishing income. A multicriteria analysis in the National Park Corales del Rosario and San Bernardo, Colombia, assisted in the selection of relevant indicators to assess the effectiveness of management from different perspectives and enhanced collaborative monitoring programs for more objective decision making.

## Management and Policy Implications

Socioeconomic assessments play a critical role in reef management. It is, therefore, imperative that they be better incorporated into the decision-making process that has traditionally focused on ecological data. A range of recommendations for improving the incorporation of socioeconomics into reef management is provided. Because socioeconomic assessments often contribute to stakeholder participation in decision-making, recommendations are also provided related to stakeholder participation.

## Specific Recommendations for Action

- Consider socioeconomic assessments as a means of building stakeholder participation, developing a

synthesis of management goals, developing long-term plans and ensuring a balance between ecological, social and economic factors in reef management

- Use multivariate analysis of data to correlate socioeconomic variables with other aspects of management, such as to determine which variables contribute to successful protected areas or which variables (for example, income, education level) were impacted by a particular management strategy (for example, fishing restrictions, awareness program)
- Include social data concurrently with ecological information through such analyses as Town Resource Cluster Analysis, which defines clusters of coastal communities associated with fisheries resource catchments to determine the social impacts of fisheries structures and management regimes
- Conduct socioeconomic assessments such that they address the social, economic, political and institutional context in which a system is operating
- Build multiple stakeholder participation through trust building, inclusiveness, information sharing and the validation of local knowledge and experience
- Realize that successful participatory approaches depend on institutional pre-conditions including: proactive government agencies that foster public participation, inclusion of all elements of society in decision-making, shared responsibilities at all stages of decision-making, and free flowing information sharing and communication
- Ensure stakeholder participation occurs at all phases, there are representatives from all the stakeholder groups and that these representatives adequately cover the diversity of interests with the groups, the process is open and flexible and there are opportunities for general public input.
- Include in the monitoring programs the spatial and temporal measurement of socioeconomic indicators useful in decision making.

## Useful References and Resources

This paper is based upon presentations at the 9th International Coral Reef Symposium, Mini-Symposia C1, *Bringing Social Sciences and Economic Issues into Coral Reef Management*. Authors and titles of presentations can be found at: [www.nova.edu/ocean/9icrs/](http://www.nova.edu/ocean/9icrs/).

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# The Economic Importance of Coral Reefs

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## Statement of Issue

**H**EALTHY coral reefs provide the economic base for millions of artisanal fishermen and thousands of small and large tourism enterprises in tropical countries. In many areas, the economic value of these contributions is poorly understood. The overexploitation of reef species and the widespread deterioration of the reefs are threatening this natural resource that often forms the sole source of income. Thus, both policy-makers and reef managers urgently need to suggest and implement measures to arrest the decline of this crucial natural resource, to mitigate the detrimental economic effects on coastal dwellers and businesses and to raise the awareness about the large economic contribution made by this resource to coastal economies.

## State of Knowledge

Despite their major economic importance, pioneering work to assess the value and economic implications of coral reefs started only recently. In this specialized area where economic and ecological issues are closely intertwined, thorough analysis of the present situation and specific recommendations for sustainable reef use were presented during a session of the 9<sup>th</sup> ICERS. A consensus exists that human induced reef destruction and overexploitation is often driven by economic forces. Disturbing quantitative data were presented which estimated the economic losses to society due to blast fishing, overfishing and increased sedimentation levels for reefs in Indonesia and the Philippines. However, positive signs involving the involvement of local communities in reef management as well as in the sharing of economic benefits were also shown for Indonesian and Philippine reefs. Studies aimed at improving the understanding of the mechanisms driving local reef management indicated that co-operation between national agencies, non-governmental organizations (NGOs) and local communities require better communication and a closer consultation process. Conflicts between stakeholder groups may also hamper the



Process of drying fish; Lampung, Indonesia

Photo: Coastal Resources Center, URI

progress of sustainable reef use. At the 9<sup>th</sup> ICERS it was agreed that ways of involving all reef users in the management process were suggested, including a sustainable funding mechanism.

## Relevant Actions Being Taken to Address the Issue

The examples of Apo and Gilutongan Islands, Philippines, show that under the specific conditions of these small islands, (1) selected reef areas can be successfully protected if managed by local communities and (2) the fishing communities can benefit financially from improved fish catch and tourism to the island. Pearl farms in Indonesia generate employment opportunities as well as protecting selected reef areas. However, some fishermen have lost fishing grounds and have thus suffered economic losses. Various case studies have quantified the considerable economic opportunities and benefits if reef areas are utilized and managed in a sustainable way. Case studies have also shown that by raising the economic valuation of reefs in the local management context, a better awareness results that encourages some local governments to invest more in their coral reef protection programs as a regular feature of the government's budget and activities.

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## Management and Policy Implications

In various presentations, the involvement of all stakeholders in the co-management of coral reefs was seen as a key requirement for sustainable reef use. Furthermore, stakeholders need to be convinced that sustainable reef management practice provides them with sufficient economic benefits. Further specific actions to enhance the current reef use patterns were made on local, national, and global levels.

## Specific Recommendations for Action

At a local level:

- Initiate programs in which users or tourists are asked to pay a user fee, such as a voluntary hotel room fee. A user fee for small marine protected areas can more than cover the cost of protecting the reef complex from destructive fishing and other illegal activities.
- Establish co-management structures, involving fisher folk and tourist operators, that can address conflicts and add economic benefits.

At a national level:

- Identify the total economic value of reefs on a national level based on currently available models in relation to the probable costs of management
- Identify costs to society caused by unsustainable reef use on a national level based on existing work in Indonesia and the Philippines and incorporate in cost-benefit analysis to highlight the cost effectiveness of preventive management for reefs.

At a global level:

- Compile all major findings on quantitative economic values and add as a module to an existing global database for example ReefBase.
- Enhance government and NGO assistance to communities to optimize effective and long-lasting communication links to channel management advice
- Reduce overall fishing effort by focussing on a collaborative enforcement between government agencies and the communities.
- Promote practical management regimes that involve stakeholders in the resource base.



Photo: Barbara Best

Dive boats tied up at mooring buoys on the edge of Gilutongan Marine Sanctuary, Cebu, Philippines

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Web site: <http://www.economics.iucn.org> includes downloadable papers such as *Economic Values of Protected Areas*.

# Building the Capacity of Those Who do the Work

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## Statement of Issue

The path to effective coral reef management and conservation involves several steps (see Steps A-D, Figure 1). Scientists and practitioners together form an important and complimentary partnership in navigating the path to effective management. The symbiotic (or interdependent) relationship between researchers and practitioners has been inadequately recognized in most management efforts historically, leading to ineffective coupling of knowledge and action.

This paper summarizes results and policy recommendations aggregated from nearly 40 papers presented during the single largest mini-symposium held during the 9<sup>th</sup> ICRS Symposium and brings together the state of knowledge regarding the application of and learning on various management tools in global coral reef ecosystems during the past decade.

Summary results from the 9<sup>th</sup> ICRS can be categorized within three areas of learning: (1) determination of factors of success; (2) documentation of factors that limit the impacts that have been achieved to date; and (3) notable progress in the practice of applied coral reef science.

## State of Knowledge

### *Shared Factors of Coral Reef Management Success*

Over half the papers in this mini-symposium documented factors that either led to successful or failed coral reef conservation, allowing lessons to be drawn from specific sites. Many of the factors identified and analyzed were social and institutional variables that are often overlooked when considering the complexities of coral reef management. Among the scores of factors discussed, four stood out as the most commonly shared across study sites:

- (a) Demonstration of Economic Benefits: With the majority of the world's population living



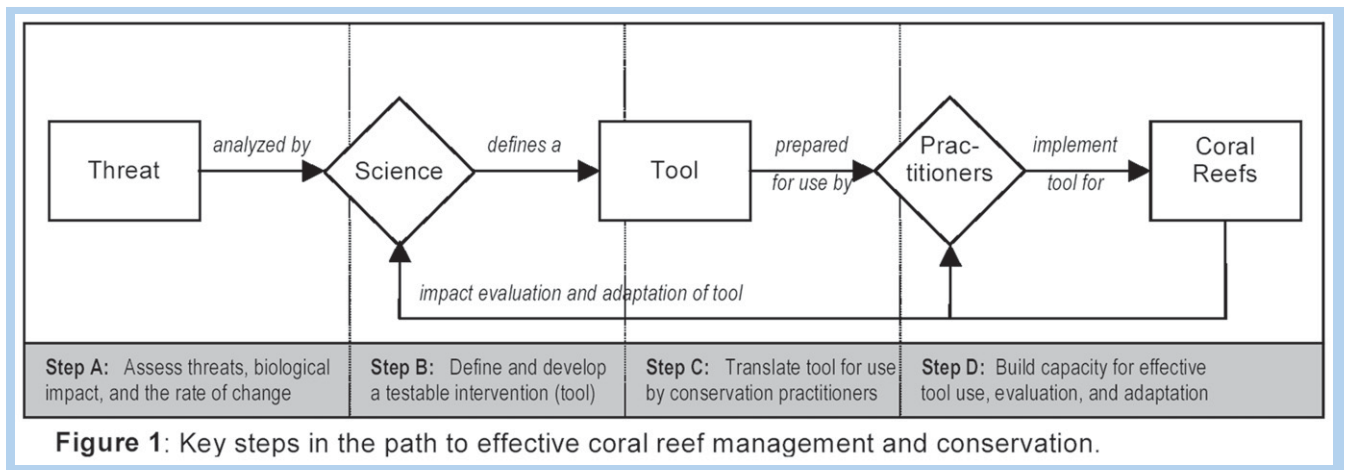
Small group workshop for those who do the work

in the coastal zone and dependent upon the natural resources therein, building capacity for *in situ* biodiversity conservation typically requires some degree of congruence with economic needs when people are involved. Nearly two-thirds of all papers cited the critical role of demonstrating short and long-term, tangible economic benefits of management tools to reef resource users.

- (b) Collaborative Management Arrangements: The degree of success experienced was in part determined by how well management responsibilities and partnerships were established. Many presentations advocate using a collaborative management (co-management) approach to ensure conservation success, where both the local communities/users and government agencies share an appropriate level of responsibility and participation in the employment of management tools.
- (c) Integration of Traditional Knowledge and Science: In-depth traditional knowledge and

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elaborate systems of customary marine resource management practices are a part of the cultural identity of many coastal residents today. Typically such practices have been weakened or lost as a consequence of global cultural change, as well as the fact that such practices alone are insufficient to address the litany of threats present. Half of all studies found that when customary practices and sources of traditional knowledge are appropriately and effectively integrated with contemporary management approaches, conservation success is increased.

- (d) **Clear, Equitable, and Integrated Governance:** Appropriate property rights arrangements are essential for long-term coral reef conservation success. Minimization of conflicts, clear and equitable delineation of resource tenurial rights, and legal support from policy makers were all seen as critical components in achieving this factor. There was also tentative evidence that linking management initiatives across different levels of governance, from site to national levels, increases the effectiveness and efficiency of conservation effort(s).

#### *Limitations to the Conservation Achieved*

Despite the remarkable learning that has been done to determine factors of success in coral reef management, the mini-symposium papers illustrated a harsh reality: the impact achieved to date has been limited, and there are failures to match each success story documented. Limitations in this regard were identified in three areas:

- (a) **Impact Is Bound at a Site-Level:** With the majority of papers given (two-thirds) focusing their studies at a single site, the learning that has been associated with it is site-specific and difficult to confidently extrapolate lessons for a broader, geographic scale. Moreover, only one-fifth of papers presented reported being in a replication phase where site-specific approaches and lessons are actively being applied elsewhere.
- (b) **Limited Documentation of Intervention Impact:** Only one-third of all studies presented contained any documented impact resulting from the use of a particular intervention, whether in terms of conservation or increased degradation. Moreover, of these cases, conservation successes and failures were evenly reported, and the impact reported was limited to a few biological and/or socioeconomic indicators of conservation success.
- (c) **Few Long-Term Financing Mechanisms Attempted:** One of the largest limiting factors to building the capacity needed for effective management is the lack of financial resources that provide for long-term, strategic capacity building for conservation success. Few long-term financing of management efforts are being tested and of these, only a few were hailed as promising mechanisms. There was also a clear lack of consensus on agreed (or acceptable) measures of success and on what indicators can most cost-effectively be measured.

#### *Improvements in the Practice of Applied Conservation Science*

Conservation practitioner awareness of how to use science for coral reef management is improving. While measuring conservation impact is limited, the techniques and methods to do so have improved greatly. The result

is a continually improving applied science context from which practitioners can draw skills and capacity. Donors, research scientists, and managers are forming innovative partnerships and learning arrangements with conservation practitioners to improve the scientific techniques underlying the practice of day-to-day coral reef management. Despite this collaboration, however, there remain both significant gaps in our knowledge of fundamental phenomena of importance (e.g., larval dispersal patterns) and significant barriers to the integration of science in conservation management programs. Relatively few donor agencies seem prepared to invest in the scientific effort necessary to develop proper experiments (often applied ones) in conservation science. As a consequence, our learning capacity is limited and we face real risks of drawing the wrong conclusions about the efficacy of particular approaches to conservation management.

The results from using coral reef management tools over the last ten years are mixed. While there is a better understanding of how to use tools successfully and apply science effectively at certain sites, these efforts are still limited to typically site-specific conservation impact with poor capacity to support or evaluate such measures long term. As one attendee at the mini-symposium put it, “I come away feeling excited about what we are learning, but pessimistic as to whether or not our efforts will be enough in the future.”

## Management and Policy Implications

It is clear that, worldwide, capacity has increased to use coral reef management tools, and that learning has occurred at a number of sites using these tools. However, because of the highly dynamic and global nature of threats facing coral reefs, capacity for coral reef management and conservation must evolve beyond where it is today. The evidence is clear: despite the notable successes experienced at specific sites, we continue to lose coral reefs worldwide. How then do we build capacity beyond a site-level to meet the changing nature of the threats present? How can we better learn to use and adapt the tools that are available to us at a level that operates at an appropriate scale to that of the threats?

The following are a set of policy action items to build coral reef management and conservation capacity at an appropriate level in the 21<sup>st</sup> century.

**POLICY NEED 1:** Adequately Understand and Predict the Role and Influence of People

If we can adequately come to understand ourselves and social influences, then we will better understand where and how to build long-term capacity for coral reef management. But getting to this point is the challenge at hand, one which cannot be reached with a shortcut.

**POLICY NEED 2:** Conservation Impact Achieved at Scale Necessary to Meet Threats

There is an immediate need to develop an appropriate level of management capacity that will operate at a scale comparable to the litany of globalized threats which presently face coral reefs.

**POLICY NEED 3:** Long-Term Shared Management Responsibility

Half of all cases presented have moved from either strictly a community-based approach or strictly a centralized, command-and-control approach to an arrangement where the management of coral reefs are shared between local constituencies and government agencies, thereby allowing for increased capacity to use the tools available and shared management responsibility over them.

## Specific Recommendations for Action

The following are a set of action items for policy makers that will contribute to ensuring that the necessary capacity exists to use available tools effectively.

■ *Expand the Participation and Integration of People in Management*

The devolution of management over coral reefs and other coastal resources is underway worldwide. To be implemented effectively, management capacity must be built at a level where local resource users and coastal residents are effectively engaged in management process and actively participating in the application of relevant interventions. This in turn helps to engender ownership over management processes and galvanize public support for such efforts. Local stakeholder participation is essential to coastal conservation success and should be continued and appropriately expanded. In particular – and as cited by over 80 percent of the papers presented – traditional management can, is, and should be integrated with the science behind the tools that are being used for conservation. This was one of the most strongly voiced policy recommendations across the 40 papers.



- *Improve the Science Explaining Human Behavior and Societal Influence*  
 It is not enough to understand that people's actions affect coral reefs; we must also learn how to predict the impact of human behavior on coral reefs based on the social and legal issues at hand. Accordingly, the session recognized that priorities for management and finances need to be driven by social criteria as well as ecological and biogeographical ones. Our ability to strategically act to foster successful management is first dependent on our ability to predict and counter the social operating conditions negatively effecting adjacent coral reefs. Applied marine conservation science must include behavioral research in order to improve the integrity and efficacy of management and policy actions.
- *Increase Support to Those Who Actually Do the Management Work*  
 The financial support for actually doing coral reef management is limited and highly competitive to secure. While financial support to scientific research and in the development of marine conservation tools is important, future funding must be made available for practitioners who inevitably determine the scale of conservation impact achieved.
- *Manage at an Ecosystem Level, Not Just a Site Level*  
 While site-based management is important, replication of site-level lessons and conservation impact needs to be scaled-up at larger temporal spatial scales in order to meet the threats operating. There is a critical need to adapt conservation approaches so that they are able to operate at an ecoregional level in order to safeguard ecological functioning, not just *in situ* biodiversity. To do this, our understanding of biological interconnectivity and representivity must be improved through the exploration of marine corridors and networked conservation efforts at a large spatial scale, given biophysical, life history, and larval recruitment factors.
- *Secure the Support Needed to Operate at a Scale Comparable to Threats*  
 There is an acute and immediate need to significantly increase funding allocated for global coral reef conservation work to allow it to operate at a scale that is capable of mitigating globalized threats. While supporting ongoing site-based management and exploring innovative alternative financial mechanisms is critical, the reality is that without the development of a strategic plan for the long-term financing of

conservation work that is shared equitably on a global level, management efforts will remain bound at a scale that is unable to result in the effective and sustained coral reef conservation.

- *Establish Learning Networks Across Sites*  
 Learning must evolve past being site- or organization-specific if we are to improve the practice of conservation. Networks of sites using similar tools need to systematically test a commonly shared set of assumptions with standardized measures to determine the conditions under which such tools work and do not work at scales beyond the site level. Through such learning networks, group learning and adaptive management can be promoted so that regional and global policy-making guidance can be provided on effective use of coral reef management tools.
- *Improve the Analytic Capacity of Those Working at a Site Level*  
 To scale-up conservation impact, learning and adaptation must occur consistently and confidently across sites. Skills building for impact monitoring and evaluation will improve capacity for long-term adaptive management at site and network levels. Appropriate analytical tools to evaluate changes and impact at an ecoregional level are required.
- *Employ Collaborative Coral Reef Management Approaches*  
 Collaborative management (co-management) approaches should be used in future coral reef management efforts to establish long-term partnerships of shared and complimentary responsibility between governments and the people and communities who depend upon the goods and service that coral reefs provide.
- *Systematically Integrate Management Efforts*  
 As illustrated under Policy Need 2, while many of the cases presented focused on new and innovative approaches to management of corals reefs at the site scale, very few demonstrated how these initiatives can cumulatively impact policy and programs at broader scales. Such impact will be essential if the initiatives begun under the guise of pilot projects or as seed investments are to yield a significant conservation gain in proportion to the threats facing coral reefs. A systematic approach to integration of management efforts can be undertaken in many ways; however, those efforts that employ an integrated coastal management framework seem best placed to achieve

effective governance and to link meaningfully with other initiatives at national scales.

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# Communicating Reef Science and Environmental Education

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## Statement of Issue

As in every specialty field, reef science has its ample share of jargon, acronyms, and technical terms. What happens, however, when a government agent needs to make a key decision that greatly affects coral reefs, but he or she does not understand this “language?” What kinds of opportunities are lost when we have several scientists working towards obtaining reef status data, but they are unaware of each other’s efforts and methodology?

Questions of this nature were the motivating factors for the facilitation of this session at the 9<sup>th</sup> ICERS. The session presentations were highly varied and offered insight from several different reef science communication perspectives, such as: how scientists disseminate information to each other, the media, and the general public; the effectiveness of live interpretation; and the approach and methodology involved in educating youth and adults about reef science.

## State of Knowledge

### *Communicating Reef Research*

In the process of communicating coral reef research findings, whether it takes place between fellow scientists or scientists and the public, time is often critical. In regards to reporting coral reef monitoring, “...the results of monitoring are most useful, and sometimes only useful, if they are analyzed and presented to users quickly.” Strategizing and streamlining of the processing and dissemination of information was encouraged to provide findings most efficiently.

On an opposite note, however, we must also assess the consequences of sharing ‘too much’ information without taking the time to evaluate the potential outcomes. If the information can be used in an exploitative manner, we may be doing a disservice to the very element we are working towards protecting. For example, one organization limits and protects data on restricted fish species on their public Web site.



Reef Check drawing by school child in Indonesia

Photo: Reef Check

In questioning the validity of certain research projects, we often forget to ask if there is an easy means, or venue, for sharing results with other researchers and with the public at large. As we head towards the future, it is highly recommended that we make this a standard of validity.

### *Sharing Information with the Media*

When scientists share information with the media, there is a two-way responsibility. Scientists must speak to the media in a way that is comprehensible and conveys a certain degree of passion or interest for the reef. The media must make an effort to put the subject in an appropriate light, avoid sensationalism and provide accurate and truthful information to the public.

If the scientist does not convey a passion for, or interest in, his or her subject, a large gap is left for the media to fill in. A journalist may be in a situation to search for ways to fill in this gap, to make the story appealing. It is best if the scientist can offer the appeal, as to ensure a more exact story. Scientists are often in a position where they must give gray answers to seemingly black and white questions. One of the main scientific understandings that the media must take to heart is that an ‘ambiguous’ answer usually

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indicates that there has not been enough research done to give a more definitive answer. It is therefore the responsibility of the media person to convey this ambiguity in a manner that reflects the integrity of the scientist, the subject, and themselves.

#### *Choosing the Right Language*

It is imperative that scientists be aware of the language that they are using when they speak to a non-scientist, assuring that their choice of words can be understood and interpreted by the listener. Certainly, there are times in science when there are no lay terms for what is being discussed, and the introduction of new words or concepts is necessary. The responsibility, in this case, lies in the scientist's ability to be aware of new word or term introductions and to define them, and the listener's ability to question unfamiliar material.

In communicating reef science, one of the strongest tools that humans have is other humans. The value of personal connection, the nurturing of ideas and the human investment should not be underestimated. Interpretation of nature is an ever-expansive field and a career pathway that should receive more of our developmental focus.

In a formal evaluation of visitor knowledge of coral biology before and after visiting an exhibit, with and without live interpretation, it was found that live interpretation resulted in statistically significant improvement in the visitor's understanding of coral biology.

#### *Use Universal Concepts and Traditional Culture*

As we interpret nature, more specifically the coral reef ecosystem, the use of universal concepts is a very effective teaching approach. People can readily relate to the ideas of finding shelter, satisfying hunger, competing for space and finding a mate. In addition to the presentation of universal concepts, highlighting the intimate relationships that indigenous peoples have developed with their environment is also a recommended interpretive approach. We have a responsibility today to look back upon ancient truths and to integrate them into today's environmental teachings. The interpretive model can be based upon the marriage of the modern day knowledge of marine biology, with the ocean knowledge and practices of the traditional culture.

Coral reef education should be an integral part of all aspects of environmental protection and resource management, beginning with young children, and it should

be built systematically throughout a person's lifetime. The process must be tailored to the local, social, culture and political climate. As we look at including indigenous wisdom into modern day practices, we also need to honor the individual ways that cultures have evolved into their modern day state.

## **Management and Policy Implications**

It is easy to lose sight of the global picture when so many scientists and field workers are involved in researching specific areas relative to coral reef ecosystems. This is why it is necessary to always take a step back and review our common goals. In terms of preservation and conservation, time is precious and does not leave room for egocentrism. Perhaps, if Darwin and Wallace had been able to collaborate more in their day, we would have a better understanding of biogeography today.

## **Recommendations for Action**

#### *For Scientists and Media:*

- Collaborate on reef science data analysis and dissemination methodologies.
- Report research results in a timely manner.
- Evaluate the content and manner in which reef information and data is publicly shared.
- Demonstrate a mutual respect for each other's field knowledge limitations

#### *For Public Education Facilities:*

- provide quality interpretation of the issues at hand.
- Prepare today's youth for tomorrow's oceans.
- Maintain an awareness of the diverse relationships that exist between humans and nature in different countries and cultures.

## **Useful References and Resources**

This paper is based upon presentations at the 9th International Coral Reef Symposium, Mini-Symposia C3, *Communicating Reef Science*. Authors and titles of presentations can be found at: [www.nova.edu/ocean/9icrs/](http://www.nova.edu/ocean/9icrs/).

[www.seaweb.org](http://www.seaweb.org) SeaWeb is a project designed to raise awareness of the world ocean and the life within it.