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International Environmental NGOs and Conservation Science and Policy: A Case from Brazil

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As anthropogenic stressors on marine environments increase, the translation of marine science into beneficial policy outcomes becomes ever more crucial. International environmental nongovernmental organizations, with linkages to both the scientific community and the worlds of policy at multiple scales, are ideally situated to cross this science–policy boundary. This article uses the experiences of Conservation International's Marine Management Area Science program (MMAS) in Brazil as a case study of the development and application of science to policy. Qualitative data about MMAS in Brazil was gathered as part of a multi-sited ethnographic research project, with methods including document analysis, direct observation and semi-structured interviews. Findings indicate that Conservation International in Brazil informed and drove policy by (1) designing scientific studies to be both locally and globally salient, (2) ensuring participation of key stakeholders during the entire research cycle, (3) communicating understandable results to disparate audiences, and (4) building a political constituency for policy changes. Organizations wishing to translate science into policy must have a comprehensive research planning, data collection and analysis, and result dissemination process that pays heed to the aforementioned elements.

Keywords Brazil, coastal, Conservation International, nongovernmental organizations, science policy translation

Introduction

Around the world, marine environments are facing a wide variety of threats, including overdevelopment (Fabbri 1998), overfishing (Jackson et al. 2001), land-based pollution (Daoji and Daler 2004; Edinger et al. 1998; Shahidul Islam and Tanaka 2004), and global climate change (Walther et al. 2002). The destruction of marine ecosystems seems unstoppable. Ninety percent of predatory fish have disappeared from the oceans since 1950 (Myers and Worm 2003). Coral reefs that are home to substantial biodiversity and provide food and income for hundreds of millions are collapsing (Hoegh-Guldberg 1999). Aware of this degradation, marine and coastal scientists—a field based in studying the causes and solutions to environmental stress—want to see their work be applied in the world of policy

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(Christie et al. 2005; Sorensen 1997), while managers and policymakers want rigorous scientific knowledge to inform as well as support their decisions (Tribbia and Moser 2008).

How can this gap between science and policy be crossed, given differences in professional training, project timelines, and even scientific priorities? Scientists place a premium value on scientific credibility—objective, reliable and valid data produced in the context of the peer review process (Clark and Majone 1985)—while environmental managers and policymakers may place the highest value on saliency and the relevance of the information to their immediate decision-making needs. Linking science to policy also necessitates managing priorities among different actors at varying scales (Cash and Moser 2000); creating scientific outputs that have only global relevance ensures that they fall on deaf ears when interpreted by local actors.

Scholars have found that for science to move policy there must be work across *boundaries* (Jasanoff 1987), defined as the "socially constructed and negotiated borders between science and policy, between disciplines, across nations, and across multiple levels" (Cash et al. 2002, 1). Scientists and policymakers draw intellectual boundaries around their areas of expertise, and resist intrusion by outsiders in order to protect their claims of authority and legitimacy (Gieryn 1995; Jasanoff 1987). However, boundaries are not immutable barriers, but rather are continually socially reconstructed and thus amendable to spanning (Jasanoff 1987; Star and Griesemer 1989). One way of spanning the science–policy boundary is through *boundary organizations*. Boundary organizations' most critical attributes include accountability to and enabling participation of actors on all sides of the boundary (Cash 2001; Clark et al. 2002), serving to create and utilize linkages that connect scientists to managers and policymakers through formal and informal processes at multiple scales. Boundary organizations discard the idea that the worlds of science and policy should be separated, and instead bring them together into a holistic web of communication that creates benefits for both while still "remaining stable to external forces astride the internal instability at the actual boundary" (Guston 2001, 41).

ENGOs as Boundary Organizations

It is instructive to consider what types of institutions can most effectively serve as boundary organizations. Boundary organizations must be able to produce (or at least aggregate, synthesize, or analyze) scientific information and then be able to translate this information into a language that managers and policymakers understand. They must have a foot in both the scientific and the policy community, so as to enable this translated information to flow between worlds of each. Historically, the production of scientific information has been the purview of academic institutions. Academia has produced individuals who study ecological relationships in the natural world for hundreds of years. Over time, academia has changed from focusing on basic research to a mixture of basic and applied research. For example, the study of protected areas and conservation biology in academia has become common (Crawford et al. 2006; Drew and Henne 2006; Lundquist and Granek 2005; Naughton-Treves, Holland, and Brandon 2005). Academia disseminates its results through publication in peer-reviewed journals and participation in conferences where scientists interact with other members of knowledge communities (Forsyth 2003). However, despite the move to more applied research, the nature of the promotion system—advancement based on scholarly published contributions—makes academia a sub-optimal position from which to launch an effort to translate science into policy (Walker 2007).

International environmental NGOs (ENGOs) are more recognizable as boundary organizations, accountable and connected to both the world of policy and the scientific

community. In the world of policy, they are now major players in environmental conservation, working with local, national, and international stakeholders (McCarthy 2005) to conserve entire ecosystems and connect local-level environmental issues to global economic and political processes (Arts 2004). They have engaged in creating and managing protected areas (Burris 2007), negotiating international biodiversity regimes (Raustiala 1997), and advocating biodiversity protection (Escobar 1998). In the world of science, international ENGOs are now staffed with ecological and socioeconomic experts, enabling the collection, aggregation, interpretation, and application of knowledge (Gemmill and Bamidele-Izu 2002) on biodiversity loss and protected area management effectiveness. They can either manage centralized in-house science programs (Da Fonseca 2003) or focus on linking with experts from scientific knowledge communities to provide scientific expertise (Haas 2004).

However, despite the growing role of ENGOs, little research has examined how they produce scientific knowledge and successfully use it to influence policy changes, with a full examination of the structure, process, and outcomes of their programs. Literature focusing on boundaries and the science to policy transition has thus far focused on units of analysis such as intergovernmental organizations (Farrell and Jager 2006), museums (Star and Griesemer 1989), local or regional regulatory bodies (Cash 2001), or professional organizations (Kinchy and Kleinman 2003). Literature focusing on ENGOs often does not look at the science to policy transition but rather focuses on ENGOs' role in community-based conservation (Zimmerer and Bassett 2003) or international political advocacy (Avant 2004; Corell and Betsill 2001; Doyle and McEachern 2007).

The intention of this article is to use Conservation International's (CI) Marine Management Area Science (MMAS) program in Brazil as a case study of a boundary organization's development and application of science to policy. Concluding in 2010, the MMAS program was a five-year, $12.5 million USD program focused on producing unique transdisciplinary applied marine protected area (MPA)[1] science that would improve management of marine areas worldwide. There were four main nodes of research and conservation work: Belize, Brazil, Eastern Tropical Pacific Seascape (main site Panama), and Fiji. In Brazil, MMAS responsibility fell to well-established CI-Brazil marine offices.

Research findings show that CI-Brazil informed and drove policy by (1) designing scientific studies to be both locally and globally salient, (2) ensuring participation of key stakeholders during the entire research cycle, (3) communicating understandable results to disparate audiences, and (4) building a political constituency for policy changes. Far from waiting until scientific projects were concluded to involve stakeholders, the ENGO engaged with them during a comprehensive research planning, data collection and analysis, and result dissemination process. Attention to *process* is increasingly recognized as a crucial focus for crossing the science–policy interface (Cash and Clark 2001; Mitchell et al. 2006). Respondents involved in marine policy decisions in Brazil indicate that the outcomes of these decisions were significantly influenced by MMAS' involvement. Policy outcomes included the establishment of a new marine extractive reserve, a signed workplan to expand an internationally known MPA, declaration of this MPA as containing wetlands of international importance through the Ramsar Convention, and contributions to the establishment of a new MPA network.

Introduction to Conservation International's MMAS Program

MMAS, funded by the Gordon and Betty Moore Foundation, had three main objectives. The first objective was to answer critical scientific questions about MPAs. As a way to protect, preserve, and promote the health of marine ecosystems and fisheries' stocks (Culotta 1994; Jones 2001; Sobel and Dahlgren 2004), promote sustainable uses of the marine environment

(Brown et al. 2001; Dixon 1993), and even reinvigorate communities' relationships to their marine resources, MPAs have grown in leaps and bounds in popularity in the last twenty-plus years. However, the science of MPA management remains incomplete. Critical questions about MPAs were answered by doing monitoring of MPAs with different zoning schemes and drawing out the effects of different management regimes on ecological, socioeconomic, economic, and cultural outcomes. The second objective of MMAS was to use the scientific projects to help build capacity in study locations. Capacity was built through involving in-country scientists in research as principal investigators and assistants and training them in ecological, social, economic, and cultural monitoring techniques. The third objective was for all of the scientific results to be translated into policy, not just aiming to produce results for publication, but to feed them into local, national, and global MPA management and policy decisions. More information about the program is available at http://www.conservation.org.

Study Site

In Brazil, CI-Brazil's marine offices were the main conduit for MMAS science production and policy action. CI-Brazil's marine field office is based in the town of Caravelas in the state of Bahia, close to the Abrolhos Bank. This office worked closely with CI-Brazil's marine administrative office in the city of Salvador to coordinate the five main Brazil monitoring projects (Table 1, Figure 1).

The Abrolhos Bank in coastal Bahia is a region known worldwide for its marine biodiversity. While Abrolhos contains only 5% of the reefs in the West Atlantic, it possesses high endemism levels, 25% in coral reef fishes and 50% in coral reef corals (Francini-Filho and Moura 2008). One of the most notable biological characteristics of Abrolhos Bank is the presence of "chapeirao," mushroom-shaped pinnacles built by Brazilian coral species and up to 25 m high (Ferreira and Gonçalves 1999; Francini-Filho et al. 2008).

Several different types of MPAs make their home in the Abrolhos bank. The oldest one is the Abrolhos NP (NP), created in 1983 by IBAMA, the Brazilian Institute of Environment and Renewable Natural Resources (Werner et al. 2000). Now managed by the relatively newly created Instituto Chico Mendes de Conservação da Biodiversidade (known colloquially as the Chico Mendes Institute), the park is divided into two parts—an 11,000 hectare area covering the Timebas Reefs and a ~77,000 hectare area covering the Abrolhos archipelago and parcel of Abrolhos (Francini-Filho and Moura 2008; MMAS 2007). The Abrolhos NP is managed with the help of a consultative council made up of stakeholders

Table 1
Core MMAS scientific monitoring projects in Brazil

Core Ecological Monitoring: To establish and conduct ecological monitoring of habitats inside and outside of MPAs.
Core Socioeconomic and Governance Monitoring: To assess the socioeconomic and governance effects of MPAs.
Core Economic Valuation: To quantify the economic value of ecosystems protected by MPAs.
Cross-Shelf Connectivity: To explore importance of mangroves, marshes, and seagrass meadows to the life cycles of fish.
Inter-Reefal Mapping: To map and provide baseline data on the inter-reefal areas of the coastal ocean.

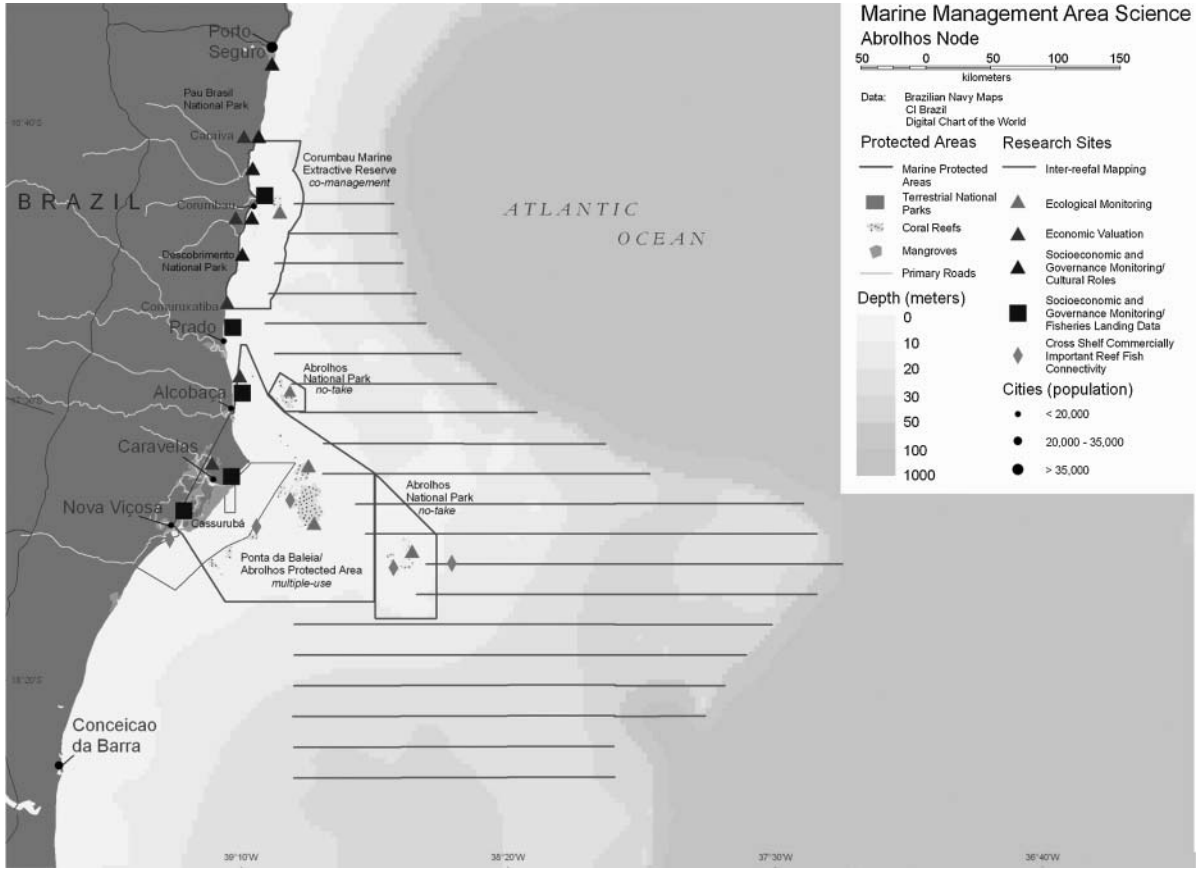

Figure 1. Map of MMAS scientific monitoring project locations. Received from MMAS staff.

including local users, NGO partners, the Brazilian Navy, and the Chico Mendes Institute, with the Chico Mendes Institute having the final say in decisions relating to the park's management.

There are several extractive reserves in the area, including the Corumbau Extractive Reserve, Canavieiras Extractive Reserve, and the newly created Cassurubá Extractive Reserve. These extractive reserves are oriented towards enabling sustainable use of marine resources for adjacent local communities. The Corumabu Extractive Reserve was established in 2000 with the assistance of IBAMA and CI-Brazil (Moura et al. 2009), and has a no-take zone covering 20% of its shallow reefs. Canavieiras Extractive Reserve was established in 2006 and Cassurubá Extractive Reserve was established in 2009. Each of these extractive reserves has a deliberative council where over 50% of the members are representatives of local user groups, enabling strong local say in the reserve's management.

The most important government environmental institution in the region is the Chico Mendes Institute. The Chico Mendes Institute is charged with management of all protected areas in Brazil (www.chicomendes.org.br). Besides CI-Brazil, key NGO institutions include Instituto Baleia Jubarte, a science-based NGO founded in 1988 dedicated to protecting humpback whales that frequent the Caravelas region, and Movimiento Cultural Arte Manha, founded in 1988 to preserve indigenous and cultural heritage in Bahia. Besides these instituted groups, the area is also home to many fishermen, peasants, property, and dweller associations and guilds.

Methods

The research on which this article is based began in early 2009, when the author began studying the MMAS program in its entirety. The examination of MMAS results in Brazil was a sub-part of the entire research effort. Field research included multiple visits to ENGO headquarters in Arlington, Virginia and the four main node sites of Belize, Panama, Fiji, and Brazil from April of 2009 until June of 2010. Total time in Brazil was approximately five weeks and involved research in both major cities where MMAS partner institutions were based as well as research at the MMAS field study site. A two-phase research schedule provided an opportunity to observe changes, follow up on unanswered research questions, and build respondent rapport.

Methodological techniques were informed by approaches in multi-sited organizational ethnography and participatory action research. The organizational ethnographer focuses on specific organizational goals and projects (Markowitz 2001; Rosen 1991), with research discerning and uncovering the interactions of donors, field offices, stakeholders, and headquarters staff. Working at multiple sites and multiple scales helped to understand embedded networks of information exchange and action and provide interpretive detail (Marcus 1995; Pollard 2004). Participant action research (PAR) is a method of research that combines credible research with real world efforts at social and/or organizational change (Baskerville and Wood-Harper 1996). The research process is oriented around the researcher working closely with the organization or social group in an iterative manner. The goal is to make the research questions directly applicable to the organization's goals, discuss findings as they appear, and have the organizational staff participate in data gathering and preparation (Baskerville 1999; Whyte 1989).

Research for this article involved ongoing collaboration with CI to produce results that were helpful for organizational learning. Insights and analysis was fed back through processes such as a preliminary results report, in-person meetings, short node reports, and workshops. Rigor of scientific conclusions were protected by designing a memorandum of

Table 2
Sample interview protocol

1. Please state your name, and briefly detail your professional credentials and work history.
2. What do you do in your current position? Whom you work with most closely with on a daily and weekly basis?
3. Tell me about your exposure to the MMAS program.
4. What projects have you been involved with or been exposure to? What has been the nature of the involvement?
5. Whom have you interacted with regarding these projects?
6. When, and how frequently, have these interactions taken place?
7. How has your participation in the projects been encouraged? Did you feel like there were attempts to ensure your input into the scientific projects during their design, operation, or conclusions?
8. How useful do you view the work of MMAS projects in contributing to your organization's goals? Will you use the scientific results?
9. How useful do you view the work of MMAS projects in contributing to conservation in Brazil?
10. What have been some of the impacts of the MMAS projects? What factors have enabled these impacts to occur?
11. Has MMAS built local capacity? Have they build capacity within your organization?
12. What do you view as some of the MMAS' strengths?
13. What do you view as some of the MMAS' weaknesses?
14. Please give me any additional thoughts about the MMAS initiative.
15. I am looking to talk to other about MMAS. Could you suggest other people to talk to?

understanding that was reviewed and agreed to by key personnel, giving the author total control over published content.

Due to the multi-sited nature of the MMAS program, the knowledge of key individuals, and the need for "thick description" (Geertz 1973) of project activities, qualitative methods were used to gather data. These methods included direct observation, document analysis, and semi-structured interviews. The author attended meetings in Arlington Virginia and at node sites and took notes on interactions among MMAS staff, researchers, and in-country stakeholders. Document analysis included examining annual reports, organizational and program timelines, budgets, project workplans, project reports, and other documents.

Semi-structured interviews are an effective method of gaining large amounts of relevant first hand information from key respondents (Bernard 2006). Semi-structured interviews were conducted with a representative cross-section of policymakers, local stakeholders, partner organizations, and scientists who worked at each node site. The intention of interviewing this cross section of people was to get a variety of perspectives across the science–policy boundary. An initial listing of respondents was gained from a CI employee and then expanded based on peer referrals and on MMAS documents and publications. Using a standard semi-structured interview protocol customized for each respondent "category" (i.e., village-level stakeholder, scientist, NGO employee, etc.) allowed an uncovering of detail as to the MMAS science planning, data collection and analysis, and result dissemination process (Table 2).

Table 3
Respondent organizations in Brazil

1. CI-Brazil staff in Brasilia, Salvador, and Caravelas
2. Fundação Getúlio Vargas (FGV)
3. Universidade de São Paulo (USP)
4. Universidade Estadual de Maringá (UEM)
5. Universidade Estadual de Paraíba (UEPB)
6. SOS Mata Atlântica
7. Grupo Ambientalista da Bahia (Gambá)
8. Movimiento Cultural Arte Manha
9. Instituto Baleia Jubarte
10. Instituto Chico Mendes de Conservação da Biodiversidade (Chico Mendes Institute) in Brasilia, Caravelas, Corumbau and Canavieiras
11. Secretaria Especial da Aquicultura e Pesca (Ministry of Fisheries and Aquaculture)
12. Community groups and villagers associated with MMAS studies in Caravelas, Corumbau, and Canavieiras

In Brazil, interviews were conducted with thirty-three respondents based in Brasilia, São Paulo, Salvador, Caravelas, Corumbau, and Canavieiras in November 2009 and May 2010 (Table 3). An interpreter provided simultaneous translation for all Portuguese interviews. Five key respondents from the United States also helped to inform this article. All interviews took place in line with accepted informed consent procedures, and were transcribed after being recorded. Once transcribed, interviews were coded using NVivo qualitative analysis software (Richards 1999). The grounded theory coding methodology (Glaser and Strauss 1967; Strauss and Corbin 1990) was used to comb interview transcripts for emerging themes and placed them into categories and sub-categories that formed the basis of empirical and theoretical arguments.

Results

Phase One—Research Planning

CI-Brazil was involved with MMAS since its conceptualization, having heard of the concept shortly after the Defying Ocean's End conference in Los Cabos, Mexico in 2003. This conference was the catalyst for MMAS as it prompted thinking about constructing a comprehensive MPA science program with the support of the Gordon and Betty Moore Foundation. After headquarters began to gauge interest with their field offices about participating in the initiative that would become MMAS, CI-Brazil let it be known that they were interested. In 2004 and 2005, CI-Brazil worked with the Center for Applied Biodiversity Science branch (CABS) of CI-Arlington to contribute to the executive proposal for MMAS to the Moore Foundation.

In 2006, after individuals at CI-Arlington had constructed the overall MMAS structure, CI-Brazil (thereafter known as the ENGO) began to work to draft workplans for the individual Brazil studies. Local salience during this process was gained in three ways. First, the ENGO joined with scientists at Brazilian universities to construct the workplans. As opposed to hiring consultants, scientists were brought in as partners, thus enhancing buy-in and creating opportunities for follow-up work. Universities most heavily involved

included Fundação Getúlio Vargas (FGV), University of Sao Paulo (USP), Universidade Estadual de Maringá (UEM), Universidade Estadual de Paraíba (UEPB), and the botanical gardens of Rio de Janeiro. University scientists were recruited based on their knowledge of the Abrolhos region, the ENGO's employees' professional and personal networks, and scientist's ability to contribute to rigorous scientific exploration. Scientist's position's in universities, independent involvement in various partnerships and working groups, and past work in the region allowed them to understand local needs and incorporate this knowledge into workplans.

Second, meetings were held with governmental partners—such as the Chico Mendes Institute—in Brasilia. The meetings focused on how MMAS studies could be oriented toward meeting the environmental information needs of the Brazilian government and served to build trust that would be crucial in the later stages of the research process.

Third, the ENGO had been working in the Abrolhos region since 2000 and was well integrated into the local governance context. As a member of both the Abrolhos NP consultative council and the Corumbau Extractive Reserve deliberative council, they were able to use bi-monthly council meetings as opportunities to connect with policymakers, managers, NGO partners, and local users and understand knowledge needs. A physical presence in Caravelas allowed interactions with fishermen, peasants, property, and dweller associations and guilds.

> We were already engaged into assisting them. We were already supporting the national park on the board and doing the day by day management. So we got a sense, had a sense of what the national park's needs were. We were running projects with the Corumbau association, so we knew what the needs were in terms of knowledge. (Dr. Rodrigo Moura, head of CI-Brazil marine field office in Caravelas)

The MMAS workplans were written so as to add to ongoing ENGO scientific work. The ENGO had been running ecological monitoring at various locations in Abrolhos NP and socioeconomic monitoring at communities of the Corumbau and Canavieiras extractive reserves. MMAS allow continuation of this five years scientific dataset and expansion into equipment intensive inter-reefal mapping and cross-shelf connectivity research.

> From my perspective, we had a good opportunity to develop a lot of things we wanted to for a long time and didn't have a chance to. The information we had, at that moment, was really important to develop things we ... we had tried before many alternatives for monitoring, we had tried before many alternatives for mapping, and that moment we really knew what we really needed to be done in the Abrolhos region. (Staff at CI-Brazil's marine office in Salvador)

Heavy engagement with international scientists and CI-Arlington in the United States occupied a large amount of time during research planning. Communications ensured that workplans fit into the MMAS "model" and were relevant to the global knowledge community. There were many rounds of information exchange between the ENGO, Brazilian scientists, CI-Arlington, and non-CI U.S. scientists through in-person meetings, telephone calls, and e-mails. So-called cross-node coordinators, U.S. scientists working under contract whose job it was to provide disciplinary advice across nodes, assisted the ENGO with workplan construction. Part of the MMAS model included that all workplans needed to

include sections where the policy impacts were anticipated before each study commenced and where cross-disciplinary collaborations were spelled out.

> Each of the projects has to integrate the science to action and have it clearly stated in the work plan, and there's a lot of crossover between the different studies, so you have what look like ecological studies, but they are tied into the socioeconomic studies. So you have two studies in the same place, and they are now analyzing what are the relationships between the ecological and social conditions for example. Where reef health goes down. People's livelihoods are affected. Or where tourism goes down or not. (Dr. Leah Bunce Karrer, Director of MMAS, CI-Arlington)

Negotiations were not a costless exercise. At times this communication process was frustrating as it led to an initial sense among Brazilian scientists and the ENGO of delay, bureaucracy, and micromanagement. However, the process effectively helped participants move beyond the traditional model of scientist-led research and transform into a more collaborative model involving multiple disciplines, stakeholder groups, and scales. Thus, while these negotiations took time and effort, they ended up being crucial in creating a suite of studies that stakeholders in Brazil felt would be most useful for the local context as well as globally relevant, and thus more likely to be taken up by managers and policymakers.

Key personnel at the ENGO were scientifically trained, charismatic, politically aware, and had extensive professional networks. These personal traits served to be critically important during this stage of the research process, making it easier to connect with high-level stakeholders in Brasilia, talk with scientists around the world, and gain input from local stakeholders during council meetings.

Phase Two—Data Collection and Analysis

As the ENGO and Brazilian scientists gathered data for MMAS, the studies were linked to wider coalition efforts. One such coalition was a Brazilian research project called Pro-Abrolhos. Pro-Abrolhos came out of a proposal by the Oceanographic Institute at USP to do marine biodiversity research in the Abrolhos Bank. USP needed many partners to conduct the wide range of work, and thus built a research coalition of 14 universities and NGOs throughout Brazil. The ENGO was recruited to be part of the coalition due to its recognized scientific expertise and knowledge about the Abrolhos region. By linking with this coalition, the ENGO gained access to institutions possessing skills and technical equipment that improved both MMAS studies and the work of other partners. For example, a habitat mapping project run by USP and MMAS' inter-reefal mapping complemented each other by sharing remotely operated underwater vehicle (ROV) and side-scan sonar data.

> That's one thing I think is very nice about them [the ENGO] is that they are very willing to collaborate. That's a virtue for me. I think it is a very good virtue. Even though they have a very nice set of data they said let's do it together. I give you my data you give me yours, so. . . . It was perfect. I am really impressed with their work. (Dr. Paulo Sumida, Scientist at USP)

The ENGO interacted with many national groups through SOS Abrolhos, an advocacy coalition of 21 NGOs, fishermen and community groups, cultural movements, and research

institutions dedicated to the protection of Abrolhos Bank. SOS Abrolhos was originally created to combat the industrial shrimp farming industry and oil exploration near sensitive marine habitats, and the ENGO became engaged due to the importance of these issues to MPA health. As the ENGO lent its expertise to the coalition, it gained access to a network for exchange of emerging MMAS scientific data and creation of political mobilization strategies.

The ENGO used regular council meetings as a mechanism to keep local government and organized local user groups informed as to MMAS progress. Emerging MMAS results were also relayed through community meetings, workshops, and informal professional interactions. Nationally, ENGO personnel consistently travelled to Brasilia to share emerging results with employees of the Chico Mendes Institute and the Ministry of Fisheries and Aquaculture.

> Not to do a boring 1.5 hour powerpoint presentations, but side conversations and ongoing discussions, knowledge and . . . but if you, there are the councils and then there are other ongoing processes, like the syndicate, the union of peasants. They are building a project so we are building capacity and inputting knowledge from MMAS. Just using the example today, but this is how it is happening. So it is not just in the bimonthly council meetings, it is everywhere, it is a continuous process. (Dr. Rodrigo Moura, head of CI-Brazil marine field office in Caravelas)

The ENGO involved community members in the production of scientific knowledge through local capacity-building programs. One program that aimed to do this was the "Open your Eyes to Science" program, an interactive internship course started by a MMAS scientist at UEM and subsequently run through a partnership between the ENGO, UEM, Bahia state organizations, and the Brazilian Ministry of Science and Technology. The main elements of the program was to pair students with scientists working on MMAS studies and require them to both assist the scientist and develop an environmental research project of their own. The students were fully engaged in every aspect of the research activities, from field data collection to analysis. This program assisted with community outreach as these students then discussed benefits of Abrolhos with their families and others, fueling a change in environmental attitudes among local stakeholders in communities.

> I believe there has been a change. The prejudice was very great against outsiders. And I see it has been getting better. . . these young people are becoming [information] multipliers, with their neighbors and with their friends in the school. (Caravelas School Teacher)

Before engaging in result dissemination, the ENGO organized a three-day "S2A Workshop." They invited, and had attend, over forty individuals from local and national NGOs, user groups, the Chico Mendes Institute, and universities. Management and policy implications of MMAS' emerging results were discussed and science-to-policy translation activities were jointly planned.

Phase Three—Result Dissemination

Key findings from MMAS studies included that Abrolhos marine reserves can be effective in increasing fisheries production and providing for sustainable tourism through spillover,

that coral diseases were leading to an accelerated decline in reef health, that there is large areas of live coral cover and fish diversity inside Abrolhos' MPAs, that there are newly discovered diverse deep reefs in need of protection, that the Cassurubá mangrove area is an important area for juvenile fish to live, grow, and feed, that more families depend on Cassurubá 's marine resources (over 1,000) than previously thought, and that it is viable for local communities to increase their income with fisheries.

The ENGO recognized that the mechanisms of dissemination were crucially linked to how the results would be received. All results were distilled into easy to understand one or two line key messages. Policymakers and managers in Abrolhos and in Brasilia received information through meetings, dinners, and presentations. Continued involvement in councils enabled regular feedback to organized groups. The public was the focus of an intensive multi-faceted outreach effort, with the ENGO engaging with previously built partnerships (such as SOS Abrolhos) to herald MMAS findings and produce press releases, radio, video, and television spots. Locally, the public received banners, posters, and leaflets with simplified scientific messages and colorful illustrations and stayed involved through capacity-building programs.

This dissemination of understandable results was crucial to fight misinformation. For example, while MMAS was ongoing in Brazil, there were plans for a large shrimp farm in Cassurubá. Simultaneously, the oil giant Petrobras and the Ministry of Mining and Energy were pushing for oil drilling near Abrolhos NP. Forces behind both of the projects began spreading misinformation to local communities and sued to overturn the Abrolhos buffer zone (a zone previously established to prevent damaging activities near the MPAs). In response, the ENGO used results from MMAS studies to create a computer oceanographic current model that showed that the Abrolhos reefs would be affected by potential oil spills; they also created a video that used MMAS results to argue that a large number of families would be impacted by the shrimp farm.

> We've been working so to use solid data to convince [stakeholders] of the importance of creating such areas. Most of the areas that have been created have suffered strong political reaction, resistance from economical interests, stakeholders. Solid data was essential; as much biological and also social. . . . We've been confronted with organized disinformation. . . . So you try to disarm such things by data. (Environmental Consultant and ENGO Partner)

The ENGO built a political constituency that would support policy changes. Continued engagement with and presentation of results to allies in coalitions, government, and local councils helped to change minds and increase political pressure on decision-makers. Stakeholder openness to supporting policy changes depended on perceptions of the credibility of the information source as well as economic and political interest. The ENGO's networks and reputation helped with the former; for the latter, MMAS results helped change the calculus of interest by making stakeholders more aware of the full costs of particular policy options. For example, communication with local stakeholders about the damaging effects of the shrimp and oil drilling projects got many in these communities talking to their government representatives and supporting more sustainable development approaches.

> After three public hearings in the area they started to bring the fishermen into the meetings, so this is when they [the ENGO] found me and started to tell me the facts about what was happening and the dangers that were threatening the fisheries . . . We started to realize that there were people against the fisheries

> people, and this is when we started to take part in it with the NGO people. We got united and spent our power. (Fishermen in Caravelas)

This process of constituency-building created enemies as well as allies. The ENGO found that the owner's union, Bahia state government, and the shrimp farmers—groups that prioritized large-scale development projects over environmental protection—became antagonized.

Beyond Brazil, the ENGO worked to synthesize its results with those of other nodes to create cross-node discipline specific reports. It was necessary to work again with CI-Arlington and across nodes to adapt presentation of results to be globally comparable. Having synthesized the Brazil MMAS studies to a global model ensured that this adaptation process took only modest effort. MMAS results from Brazil contributed heavily to international transdisciplinary products that were used to influence global institutions, such as the World Bank, the Food and Agriculture Organization, and the United Nations Environmental Program.

Management and Policy Outcomes of MMAS in Brazil

Interviews with MPA managers and policymakers in the Abrolhos region and Brasilia revealed that the MMAS had been crucial in driving several recent management and policy changes. *Selected* impacts of MMAS are below.

1. Results from studies helped to create the political and technical conditions for the creation of the Cassurubá extractive reserve. The reserve was created in May of 2009 by President Lula. The Chico Mendes Institute in Brasilia confirmed that data from MMAS, and the political pressure that the ENGO and allies brought to bear, was crucial in stopping the shrimp farm and oil exploration in the Abrolhos Bank (detailed previously) and in subsequently creating this reserve.
2. Results showing that Abrolhos has high biodiversity and a more extensive reef system than previously thought spurred discussions with the Chico Mendes Institute to expand the area of Abrolhos NP. The Chico Mendes Institute signed a workplan to expand the park, and expected the entire workplan to be implemented by the end of 2011.
3. Using results from the MMAS studies showing that the Abrolhos region is high in biodiversity and worthy of protection, the ENGO collaborated with the Chico Mendes Institute to complete a Ramsar convention application for Abrolhos NP. Abrolhos NP was declared a Ramsar convention site on February 2, 2010.
4. In 2007 and 2008, São Paulo state in southern Brazil decided to create a network of MPAs. Realizing they would benefit from outside consultations, the state government invited the ENGO (among others) to help in creating an MPA technical report. This report, combined with the ENGO's and partner's involvement in political processes, enabled the establishment of a 1.12 million hectare MPA network in late 2008.

Discussion and Lessons Learned

The experiences of MMAS in Brazil suggest that ENGOs can operate as boundary organizations and successfully translate scientific knowledge into policy outcomes. Key to this translation is engaging in a research planning, data collection and analysis, and result

dissemination process that understands and acknowledges the needs of both sides of the science/policy boundary. In the case of CI-Brazil, this was done by designing scientific projects so that they were salient to both local and global stakeholders' needs, ensuring ongoing participation of and engagement with key stakeholders during the entire research cycle, communicating understandable results, and building a political constituency for policy changes.

During MMAS research planning, the major focus was global–local adaptation: to create scientific workplans that were oriented toward local science and management priorities but also within the general global framework of MMAS' scientific objectives. A mistake made at the start of the process described was that the ENGO and associated scientists were not fully aware of the time needed to do scalar negotiation, leading to a level of frustration and delay. However, while time consuming, discussions between the ENGO, CI-Arlington, and Brazilian and international scientists over the workplans enabled MMAS studies to speak to both global and local science needs and bring substantial expertise and local knowledge to workplan construction. Participation by the ENGO in governance mechanisms such as MPA councils created opportunities for regular feedback. Early discussions with stakeholders were enabled by competent, charismatic, well-trained CI employees. Discussion and negotiation of priorities between scales and between scientists and policymakers is crucial element of crossing the science–policy boundary and making the science relevant and salient to all stakeholders (Cash and Moser 2000). Salience of science to the audience to which it is presented forms the foundation of science being useful (Cash et al. 2003).

Once the data collection for MMAS studies began, the collection and analysis of MMAS scientific data depended heavily on partnerships built between the ENGO and universities during the research planning process. The ENGO linked to research and advocacy coalitions and continued feedback to government through meetings and involvement in governance mechanisms. Partnering with universities and research and advocacy coalitions enabled the ENGO to gain access networks of information exchange that allowed leverage of MMAS results. The public had a larger role, with locals involved in research projects, and thus creating "information multipliers" that laid the ground work for a political constituency for management change. Keeping partners, managers, and policymakers involved is a crucial element of boundary spanning as it increases buy-in into the results (Cash and Moser 2000; Farrell and Jager 2006; Mitchell et al. 2006; Josiah 2001).

As results started to come out, the ENGO spread them through previously built partnerships with universities, coalitions, and government and used these partnerships to stake out positions in the political process. The public continued its role as information multipliers and was involved in receiving information from videos, radio, posters, and brochures. Result translation and communication was a crucial element of the entire process as it conveyed complex scientific messages understandably. The ENGO's networks and professional reputation laid the groundwork for stakeholders to receive information; once received, information successfully changed perceptions of economic and political interest by making clear the costs of policy options. The ENGO built a political constituency that would bring political pressure to bear on decision-makers. Boundary organizations create opportunities for scientists to connect their results to a need for action while still staying members of a knowledge community (Guston 1999).

Two final points come out of this study. First, it is clear that the ENGO prioritized engagement with different groups at different stages of the research process (Figure 2). Engagement with the public, a diffuse group that may be difficult to involve in research planning, became more important as results were produced and disseminated. As the ENGO

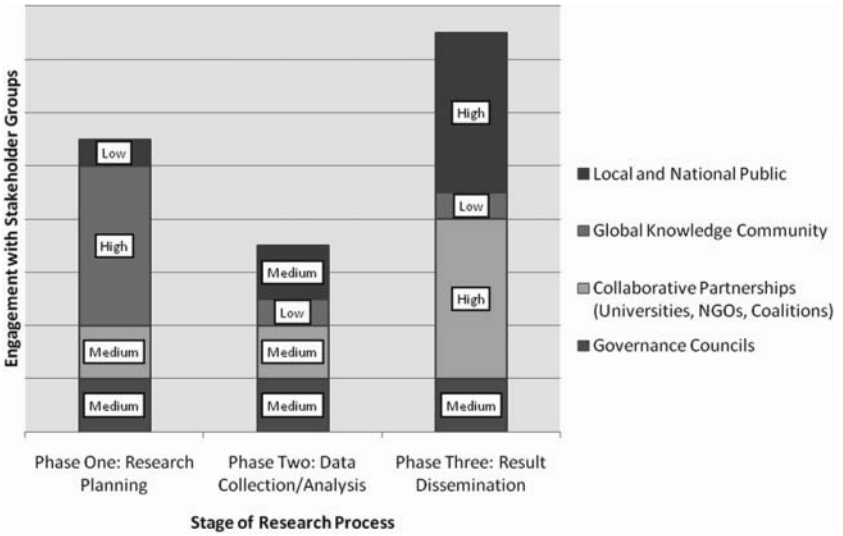

Figure 2. Engagement with stakeholder groups through the MMAS research process.

progressed through the research process, the major focus went from engaging with the global knowledge community to knowledge dissemination through collaborative partnerships and engagement with the public. This strategy was successful, resulting in significant policy changes in Brazil and contributions to international transdisciplinary products.

Finally, while this research is fundamentally about how an organization can act as a boundary organization and translate science into policy outcomes, it also reveals several other factors that add to an organization's political power. Traits inherent in both the ENGO and key personnel within it (networks, linkages to the global knowledge community, reputation, scientific training, charisma) smoothed the way for stakeholders to accept the scientific results as credible and incorporate it into policy decisions.

While the experiences of MMAS in Brazil were certainly framed by a particular social, economic, and political context, there are general lessons learned that can be drawn from its experience.

1. Scalar differences in scientific objectives must be negotiated and resolved. The knowledge produced by scientific research must speak to the needs of the audience to which it will be delivered. Time for scalar negotiation should be planned for—and expected—at the beginning of any similar research process.
2. Linking to universities and NGOs as partners brings in-depth knowledge and local familiarity to bear on research problems. Partnerships and coalitions create networks that enhance information exchange and act as tools to increase political pressure. Linkages across scales to the global knowledge community increases access to scientific expertise.
3. Managers, policymakers, and local users should be involved in every stage of the research process, from initial scientific planning to result dissemination. Permanent governance mechanisms such as councils create opportunities for regular feedback. Prioritizing *levels* of engagement with different stakeholder groups across the process maximizes policy impact.

4. Involvement of the public is crucial to build long-term capacity and create a constituency that supports action on scientific results. Scientific messages should be relayed to the public in simple, understandable, and creative ways.
5. Any opportunity to build coalitions and use scientific results in policy decisions should not be wasted. For example, large-scale threats to coastal ecosystems can draw attention to an issue and mobilize action, creating an opportunity for inputted results to have maximum influence.
6. Good people matter. Those personnel in an organization that are charismatic, politically connected, and have an understanding of how to do science and outreach to a range of stakeholders can be most useful in the science–policy translation process. Scientists involved in production of science should not be embargoed from using this science to support political positions. Often, scientists are in the best position to create tools that illustrate the full costs of policy options.
7. Do not assume that operating from a foundation of science makes one immune to making enemies. Making enemies is one of the inevitable consequences of being involved in the political process.
8. Finally, if doing a global project that takes place across countries, keep lines of communication open during the entire research process. Online tools for communication can be used for easy international data sharing and discussion, and examples from individual countries can be combined into useful transdisciplinary products.

Note

1. While MMAS used the term marine managed area (the word "protected" was seen as emphasizing human exclusivity), I will use the term more common term marine protected area (MPA) to reduce reader confusion.

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