Stakeholder Engagement in the Development of a Participatory GIS for the Grenadine Islands

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ABSTRACT

Marine resources are of vital importance to the people of the Grenadine Islands, yet planning and management of the use of marine resources of the trans-boundary Grenada Bank is becoming increasingly complex. Management thus far has primarily taken a conventional, top-down, command-and-control approach guided by standard non-specific regional management plans and based on limited biophysical information. Furthermore, marine management of the Grenada Bank has not been integrated amongst disciplines, between nations or knowledge systems. This segregated management approach has not been effective and has failed to prevent the environmental degradation of the Grenada Bank. Participatory geographic information system (PGIS) is an emerging, interdisciplinary, community development and environmental stewardship tool, based on participatory research principles. The Grenadines Marine Space-use Information System (MarSIS) is a PGIS which will integrate local knowledge, stakeholders' use patterns and socio-economic data, with conventional biophysical information, to provide for a more ethical, functional, and holistic framework for marine management. This paper summarises the various stakeholder engagement mechanisms utilised in the development of the MarSIS as a PGIS. These not only incorporate popular knowledge on marine resources, but also transparently bring a variety of stakeholders into a common space of understanding. This research tests the belief that by using participatory research, a better understanding of critical areas for livelihoods and conservation will be obtained and can facilitate more effective management of marine resources of the Grenada Bank.

KEY WORDS: Stakeholder engagement, participatory GIS, knowledge systems

Inclusión de Personas de Interés en el desarrollo de un SIG participativo para las Islas Grenadinas

Los recursos marinos son de vital importancia para los habitantes de las Islas Grenadinas, aun así la planificación y manejo del uso de los recursos marinos del bajío transfronterizo Grenadino se torna cada vez más compleja. Hasta la fecha, el manejo ha sido principalmente desde un enfoque convencional, verticalista de orden y control guiado por planes de manejo regionales, standards y no específicos, y basados en limitada información biofísica. Más aun, el manejo marino del Bajío Grenadino no ha sido integrado dentro de disciplinas, entre naciones o sistemas de conocimiento. Este enfoque de manejo segregado no ha sido efectivo ni tampoco ha sido exitoso en la prevención de la degradación ambiental del Bajío Grenadino. El sistema de información geográfico participativo (SIGP) es una herramienta emergente de desarrollo comunitario interdisciplinario y ambiental basado en los principios de la investigación participativa. El Sistema de Información de Uso Espacial Marino de las Grenadinas (MarSIS) es un SIGP que integrara conocimiento local, datos socio económicos y patrones de uso de personas de interés, con información biofísica convencional, para proveer un marco de mayor ética, funcional, y holístico para el manejo marino. Este documento resume los diversos mecanismos de inclusión utilizados para el desarrollo de MarSIS como un SIGP. Estos no incorporan únicamente conocimiento popular sobre recursos marinos, sino también transparentemente conjuga una variedad de personas de interés dentro de un espacio común de conocimiento. Esta investigación pone a prueba la creencia que el utilizar investigación participativa, obtendrá una mejor comprensión de de áreas criticas de subsistencia y conservación y puede facilitar un manejo mas efectivo de los recursos marinos vivos del Bajio Grenadino.

PALABRAS CLAVES: Inclusión de personas de interés, SIG Participativo, sistemas de conocimiento

INTRODUCTION

The transboundary Grenadine Islands are scattered between mainland St. Vincent in the north and Grenada in the south (Figure 1). This cluster of approximately 600 islands, islets and cays lies atop the Grenada Bank and extends 120 km between the two sovereign nations. Three quarters of the 3,000 km^2 Grenada Bank is shallower than 50 m and all reef-related habitats are represented: seagrass and lagoon, areas of mangrove and a variety of patch, fringing and bank barrier reefs (CCA 1991a, b, ECLAC 2004). Seven of the inhabited Grenadine Islands (Bequia, Mustique, Canouan, Mayreau, Union, Palm, and Petite St. Vincent) belong to St. Vincent and the Grenadines, and the remaining two (Carriacou and Petite Martinique) are a part of Grenada (CCA 1991a, 1991b). Marine-based activities are the mainstay of the economy of the area; in which fishing, transport and tourism are the major sources of employment (Baldwin *et al.* in press).

Both Governments perceive their Grenadine Islands as having high potential for tourism and associated development, whilst also recognising their current value and long tradition of supporting coastal communities through fishing. They are also well aware of the high vulnerability of the marine resource systems of the area, to environmental degradation, and the dependency of sustainable development on conservation of the resources (Sustainable Grenadines Project 2005). Both countries are party to a large body of international and regional environmental agreements and possess national legislation and regulations to promote sustainable development and protect and conserve marine resources and biodiversity (Mattai and Mahon 2007).

Despite this awareness, unplanned development and the unregulated use of the coastal and marine resources of the Grenadines have already led to significant degradation in many areas. Increasingly, serious infrastructural, socio-cultural, and ecological problems have contributed to the declining quality of the natural resources of the Grenadines

in recent years. Overfishing, coastal habitat destruction and degradation, sedimentation, solid waste, and sewage disposal from land-based and boat sources, as well as the recreational abuse of coral reefs have been cited as causative factors for this deterioration (CCA 1991a, b, Price and Price 1998, FAO 2000, FAO 2002, ECLAC 2004, Sustainable Grenadines Project 2005, Williams *et al.* In prep).

Figure 1. Geographic location and detail of the trans-boundary Grenadine Islands of the Grenada Bank *(Adapted from Sustainable Grenadines Project 2005).*

Historically, marine management of the Grenada Bank has primarily been administered in a top-down fashion, lacking both national integration between relevant government agencies and trans-boundary multi-sectoral collaboration. This may be, in part, due to centralisation of both governments on their respective mainland and the physical constraints of access to the dispersed chain of trans-boundary Grenadine islands. This is no doubt exacerbated by a lack of formal fisheries and marine tourism management plans, limited enforcement capacity, and non-existent formal stakeholder participation mechanisms in planning and management initiatives both within and among the countries (K.B. Unpubl. data; Mattai and Mahon 2007).

It has become apparent that coastal resource planning and management cannot be pursued from a biophysical focus alone. Moreover, fisheries are too diverse, dynamic, and complex to be efficiently managed by one institution (Mikalsen *et al.* 2007). Community attitudes towards, and uses of coastal resources have serious implications on the biophysical health of marine resources, and likewise the management of coastal resources have equally serious implications for the socio-economic health of the human communities (IIRR 1998, Bunce *et al.* 2000, Bunce and Pomeroy 2003, Sayer and Campbell 2004). Development efforts that have ignored local circumstances and knowledge systems have wasted time and resources (Grenier 1998). Therefore, by including the social frame of reference and incorporating local ecological and popular knowledge systems with traditional scientific approaches, important information gaps can be filled, potential problems can be identified and management priorities focused accordingly (Maine *et al.* 1996, IIRR 1998, Grenier 1998, Walters *et al*. 1998, Sayer and Campbell 2004, Wiber *et al.* 2004).

Furthermore, conventional top-down scientific approaches have failed to achieve the goals of sustainable development and are insufficient to respond to the complex nature of social, economic, political, and environmental challenges in marine resource management (Maine *et al.* 1996, Grenier 1998, IIRR 1998, Sayer and Campbell 2004, Pomeroy *et al.* 2004, Wiber *et al.* 2004). Academically, a paradigm shift has occurred in marine resource management which embraces the use of participatory mechanisms in order to combine quantitative and qualitative knowledge from a diversity of stakeholders, thereby allowing for improved data and information. It can also aid more 'interactive' governance by better guiding decision-making and management initiatives (Pomeroy *et al.* 2004, Wiber *et al.* 2004). Although it has been argued that in the short-term the inclusion of 'local' or indigenous knowledge through participatory research (PR) is more time-consuming and costly than conventional top-down approaches, it can provide more appropriate information for long-term planning and management initiatives. Stakeholder engagement in management can provide for: better compliance with rules, increased stakeholder capacity in problem solving and decision-making, local empowerment and community cohesion and ultimately build a more sustainable future (Grenier 1998, IIRR 1998, Cumberbatch 2001, Sayer and Campbell 2004, Wiber *et al.* 2004). In addition, it is believed that multi-sectoral collaboration and meaningful community participation involving a range of stakeholders in the information gathering, research and evaluation processes can maximise management efforts by allowing for equity in decision-making. By meaningfully including and considering both sectoral and community interests, mutual respect and understanding for management initiatives can allow for a participatory framework for co-management (Maine *et al.* 1996, Grenier 1998, CANARI 1998, McConney *et al.* 1998 Walters *et al.* 1998, McAllistar and Vernooy 1999, Renard and Krishnarayan 2000, Chuenpagdee *et al.* 2004, Sayer and Campbell 2004, Wiber *et al.* 2004).

With a heavy reliance on marine resources and increasing numbers of marine resource users in the Grenadine Islands, there is a clear need for integrated marine resource management. In order to augment

management effectiveness, it is well recognised that the resource users themselves must be a part of the data gathering and planning process and that their resource space-use profiles must be clearly understood (Walters *et al.* 1998, Bunce *et al.* 2000, Bunce and Pomeroy 2003, Chuenpagdee *et al.* 2004, Rambaldi *et al*. 2005, Corbett *et al*. 2006). A further requirement, particularly in the case of a trans-boundary area, is that information must not only be accessible and accepted by all marine resource users, but must be shared openly among the sovereign nations. Given these criteria, the Grenadine Islands were considered an ideal location to test the development of an integrated, trans-boundary, multi-knowledge marine space-use information system (MarSIS) by using a participatory geographical information system (PGIS) approach. The Grenadines MarSIS will amalgamate a variety of information including: local knowledge, stakeholders' use patterns and socio-economic data with conventional biophysical information on the marine resources, biodiversity and ecosystems of the Grenada Bank to provide for a more functional and holistic framework for marine management (Baldwin Unpubl. data).

This paper summarises the various stakeholder engagement mechanisms utilised in the development of the Grenadines MarSIS. This research utilises participatory mechanisms not only to better understand areas of importance for livelihoods and conservation; but to obtain a wider information base and facilitate more effective marine resource management.

METHODS

In order to assimilate a variety of knowledge systems in the MarSIS geodatabase, a range of participatory and communication techniques are being used to develop the Grenadines MarSIS geodatabase and are described below. The spatial data categories included in the MarSIS geodatabase contain information acquired through participatory research (PR) are listed in Table 1. This information will be merged with conventional science within a PGIS framework in an attempt to obtain a better understanding of critical areas for livelihoods and conservation, and allow for more effective management of marine resources of the Grenada Bank.

Communication Mechanisms

Communication has been encouraged among all identified stakeholders through a variety of means throughout the research process. The research objectives, the role of stakeholder involvement, and the progress of the research, including issues encountered and possible solutions, are communicated to stakeholders through both one-way and two-way channels. One-way channels include the distribution of regular newsletters, emails, flyers and technical reports. Two-way channels include the development of an internet-based Yahoo Grenadines-MarSIS e-group / website: (www.GrenadinesMarSIS.yahoogroups.com).

Through the Grenadines MarSIS e-group the research reports, website, messages, references, maps, photos, useful links, research calendar, and polls can be administered and accessed by all members. This e-group is used not only to provide easy access to the information gathered, but acts to augment transparent communication and facilitate an integrated discussion forum among all stakeholders. All stakeholders with internet access are encouraged to join this e-group and there are currently more than 170 members. Other two-way channels include periodic governmental and community stakeholder meetings. These meetings were used to introduce the project, review the objectives, periodically validate and share information collected by stakeholders, as well as to allow for feedback and evaluation of the information produced. Moreover, all stakeholder meetings and field research activities are documented in a series of summary reports and shared through both the e-group / website as well as distributed in hard copy format.

Participatory Mechanisms

The primary use of stakeholder participation in the research is to better understand and document local knowledge of marine resource distribution, abundance and space-use patterns. Secondarily, the process of PR aims to lay a foundation for social transformation and empowerment by increasing the legitimacy of local knowledge as well as supporting stakeholder education, engagement and capacity in planning initiatives. PR activities consist of: key informant interviews, participant observation, a stakeholder assessment, marine resource user inventories and surveys, interactive learning exercises, community consultations, coastal profile transect walks, seasonal calendars, semi-structured focus group interviews, and participatory mapping exercises. PR activities are guided by a combination of principles and techniques described in IIRR (1998), Walters *et al.* (1998) and Bunce *et al*. (2000).

Validation, Feedback and Evaluation Mechanisms

Periodically, information collected is presented to all stakeholders for validation and feedback through the communication mechanisms given above. A variety of Participatory Monitoring and Evaluation (PM&E) techniques, specifically the cross-checking of results through numerous stakeholder validation meetings and summary reports (Maine *et al.* 1996, IIRR 1998, McAllister and Vernooy 1999) are systematically used for learning.

Secondary Data — The research began with a review of relevant global, regional and national secondary (*i.e.* existing) data and information on marine-related legislation, policies and management plans as well as associated research on the marine environment, fisheries, tourism, civil-society, and private sector organisations in the Grenadines. Furthermore, site visits were made with all

Table 1. Spatial categories included in the MarSIS geodatabase

Spatial Categories	Description
Marine Benthic Habitats*	Reef classifications, associated fish species and organisms, spawning and nursery areas
Coastal Resources*	Key areas of use, seasonal patterns and intensity of use
Marine Biophysical Data	Bathymetry, currents, salinity, temperature
Fishing Villages/Communities	Demographics, activity profiles, socio-economic information
Important Fishing Grounds*	Key resources (i.e. fish species, conch, lobster), fishing intensity/pressure, gears used
Fish Landing Sites	Demographics, catch and landing statistics
Other Marine Resource Users	Demographics, activity profiles, socio-economic information
Areas Important for Marine-based Tourism*	Dive sites, snorkelling areas, sailing passages, anchorages and intenisty
Safe Anchorages, Marinas, Ports	Capacity, depth, infrastructure, intensity
Shipping (Commercial Use) Areas*	Inter-transit shipping routes, intensity
Areas of High Aesthetic, Historical, Cultural and Recreational Value*	
Conservation/Protected Areas	Proposed and legislated marine protected areas, marine monitoring survey information
Land-based Sources of Marine Pollution*	
Perceived Environmental Threats*	
Areas of Livelihood or Development Opportunities*	

* Indicates spatial categories in which the information base will include local knowledge obtained through the use of participatory research mechanisms

government stakeholders to source additional information and identify information gaps.

Stakeholder Identification — Stakeholder groups identified were categorised as primary and secondary stakeholders. Primary stakeholders include key government agencies (Fisheries Division, Physical Planning and Tourism) of each country and direct marine resource users of the Grenadine Islands. Direct marine resource users (MRUs) were categorized by type of use and by island and include: dive shops, day tour operators (general, sailing and sport-fishing), water-taxi operators, fishers, yacht charter companies, ferry operators and ship owners. Fishers were further grouped by landing site and analysed by fishing type (i.e.: baitfish, conch, lobster, reef fish, bottom fish and inshore/offshore pelagics). Secondary stakeholders include civil society organisations and local NGOs, other relevant government agencies (Forestry, Ministry of the Environment, Coast Guard, Port Authority, Statistics, Harbour Master, Customs and Maritime Administration) and the communities of the nine inhabited Grenadine islands.

Stakeholder Assessment — A data scoping stakeholder assessment was undertaken throughout the month of May 2006 in each of the inhabited Grenadine Islands, as well as in each respective mainland. Government institutional assessments and the identification of the abundance and distribution of direct marine resource users (including an initial assessment of the general locations of key marine resources and their current uses) was priority. Secondarily, this exercise was used to initially gain insight on stakeholder dynamics and general environmental awareness. This included the perceived value of and threats to existing marine resources and livelihoods, as well as the identification of existing conflict among users' within each Grenadine Islands' community. Information was obtained primarily through direct observation, informal conversation and semi-structured key informant interviews (IIRR 1998, Walters *et al.* 1998, Bunce *et al.* 2000). A minimum of three key informants from each MRU group were interviewed from each island. Information gathered during this data scoping assignment was also utilised to further define research objectives as well as identify subsequent socio-economic survey variables and appropriate spatial data collection tools. A summary report on the data scoping and stakeholder assessment was prepared and shared with stakeholders through communication mechanisms identified.

Basemap production — A simple basemap of the Grenada Bank consisting of coastlines, bathymetry and territorial boundaries was created in ArcMap using ArcGIS version 9.2 for spatial data collection.

In order to aid stakeholder understanding of this simple basemap for use in subsequent mapping exercises, community stakeholder mapping exercises were undertaken to determine the 'topogy' (i.e. locally-used names) for the beaches, bays, and cays of the Grenada Bank. Standard government 1:10,000 topographic maps were used for this mapping exercise due to their easy availability and community members' familiarity with major landmarks. Community members from each island were asked to provide the local names for all the beaches, bays, and cays with which they were familiar, and all names were written directly on each island's topographic map. Each map was carried around to the various communities within each island until all named coastal features were identified and general consensus gained. For each island at least three key informants verified and agreed on each local name provided, before each island's 'topogy' map was considered complete. Information collected was spatially referenced and used to annotate the simple basemap with the local names of coastal features for use in subsequent mapping exercises (Figure 2).

Socio-economic and Activity Profiles — An inventory of each marine resource user group, and socio-economic surveys were undertaken over a three month period with the assistance of four CERMES MSc research students during the summer of 2006. All survey instruments were posted on the MarSIS e-group for feedback from stakeholders before being utilised. During the MRU inventory,

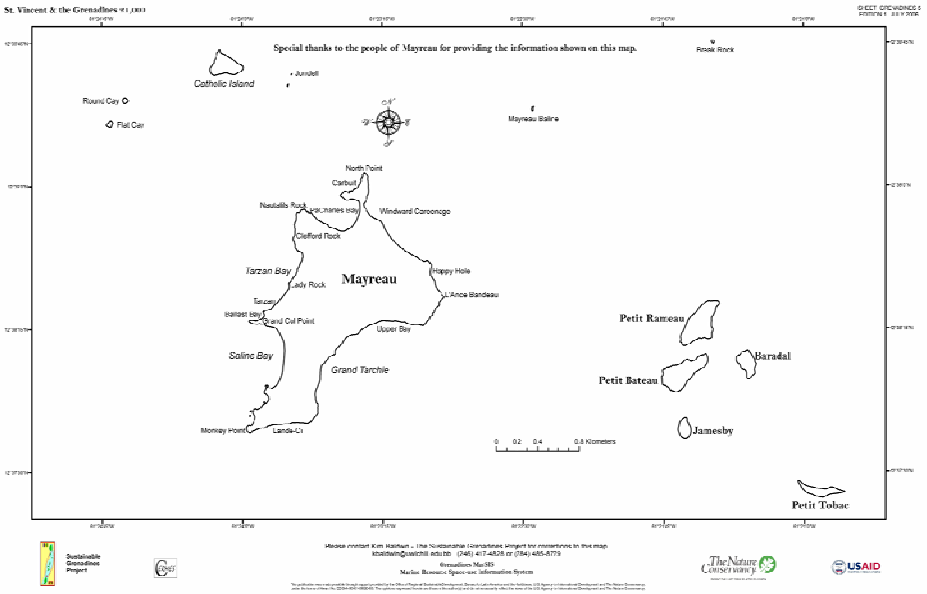

Figure 2. Example of a 'topogy' map, created to annotate the simple basemap. These maps were distributed in each respective Grenadine Island and were found to be useful in gaining additional support for the research.

444 individuals were interviewed including: 169 water-taxi operators, 267 fishers, nine dive shop operators, 27 day tour operators, six charter yacht companies, seven ferry operators and five ship owners. Information given during these interviews indicated that a total of 826 persons are employed on 519 boats currently operating on the Grenada Bank (Baldwin *et al.* 2006). Baseline marine space-use information was collected to create initial spatial activity profiles for each marine resource user group. Furthermore during October 2006, MRU activity profiles and associated socio-economic findings were presented and verified by primary and secondary stakeholders through a series of PM&E meetings (Maine *et al.* 1996, McAllister and Vernooy 1999). This was done in order to obtain stakeholder validation and feedback before being spatially translated into GIS data files accompanied by a technical report (Baldwin *et al.* 2006). Again, this report was widely distributed to stakeholders in the communication mechanisms identified.

Coastal/Marine Classification — Two marine classification systems are being developed for benthic marine resources and habitats at a broad-scale useful for planning and management purposes. A science-based classification system is being developed through the use of secondary scientific sources, satellite imagery, and conventional GIS techniques (*i.e.* ArcGIS Habitat Digitiser Extension). This classification scheme includes categories such as: sand, seagrass, coral-dominated reefs, algal reefs (low-relief), and rocky reefs (high-relief). A local knowledge classification system has been collaboratively determined with MRUs. Initially, interactive learning exercises were carried out with each type of the marine resource user to better understand, identify and classify each group's key marine areas of usage, including important resources and habitats as well as areas unsuitable for use. Additional classification will be determined through the use of coastal profile transects, seasonal calendars, and participant observation techniques where needed (Maine *et al.* 1996, IIRR 1998, Walters *et al.* 1998).

Mapping Exercises — The series of participatory mapping exercises utilised in the development of the MarSIS geodatabase consist of a combination of small semi-structured focus group interviews and individual interviews (Walters *et al.* 1998, Bunce *et al.* 2000) and shown in Figure 3. Focus group interviews are used to map coastal habitats and resources as well as to identify current or potential issues/conflicts and opportunities. Focus groups consist of a diverse group of MRUs (comprising four to six participants), a facilitator and a record keeper/computer assistant. During each series of mapping exercises at least one focus group interview is held in each of the inhabited Grenadine islands, although in larger islands, such as Bequia and Carriacou, with multiple discrete communities two to three focus group interviews are conducted for each mapping exercise. Duration of each mapping exercise is limited to two hours to minimise fatigue of participants.

At the start of each mapping exercise, stakeholders are first orientated with the basemap of the Grenada Bank

annotated with the 'topogy' or local names of beaches, bays and cays. To better orientate stakeholders with the basemap and the areas to be mapped; all mapping exercises are visually supplemented using Google Earth Web-based satellite imagery of the equivalent area (Figure 4). Each mapping exercise is concluded with a review of the objectives ensuring all topics have been fully addressed as well as time for initial validation of spatial information collected. Furthermore, after each mapping exercise data is digitized into the GIS and validated through a series of PM&E stakeholder meetings before proceeding to the next phase of mapping.

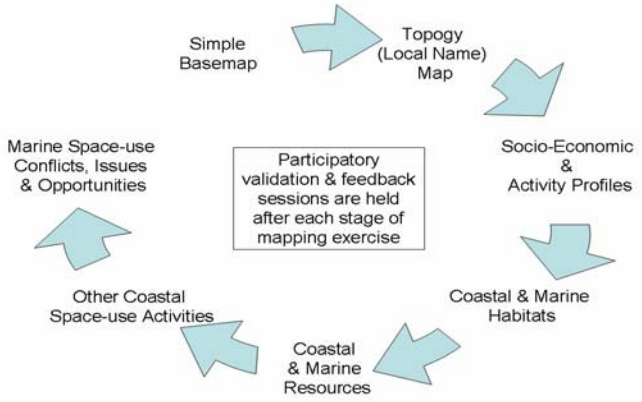

Figure 3. Flow chart of participatory mapping exercises utilised in the development of the MarSIS geodatabase

Evaluation of geodatabase utilization — On completion of the development of the PGIS geodatabase, a series of stakeholder utilisation workshops will be conducted to examine the practical application and overall usefulness of the multi-knowledge information system. A range of participants will be invited including government, direct marine resource users and civil society stakeholders. During MarSIS utilisation workshops, participants will be guided through a series of structured computer exercises to test the application and information generated from the geodatabase. Additionally, the legitimacy of local knowledge obtained through PR in comparison to conventional scientific knowledge will be investigated through the evaluation of spatial datasets. During this workshop, participants will be administered surveys to critique the overall functional usefulness of the MarSIS and evaluate the utilisation of PR methods. This final evaluation process will aim to aid inter-stakeholder understanding and support for the integrated multi-knowledge MarSIS geodatabase although this hypothesis will not be thoroughly appraised.

RESULTS

By actively involving stakeholders in each step of the research process, encouraging collaboration on methodology applied and possible solutions to management issues, the research aims to foster an equitable and transparent atmosphere. A transparent adaptive research framework is fostered through the utilisation of validation, feedback and evaluation mechanisms thereby encouraging further

Figure 4. An example of how the basemap was annotated with local 'topogy' supplemented with Google Earth satellite imagery in order to aid stakeholders' recognition in mapping exercises.

stakeholder participation in the research process. This not only provides stakeholder control over the information produced, but aids both inter and intra-stakeholder understanding and support for the MarSIS and an appreciation of the importance and role of participation in planning the sustainable development of the Grenadine Islands.

Secondary Data

Considering the geographical scope of the study area, this stage of the research was extremely time-consuming and remains on-going. Existing information was scattered across the trans-boundary island chain amongst numerous government agencies, libraries, NGOs, and community leaders and had never been catalogued before. Personal site visits and surveys administered at interdisciplinary government stakeholder meetings were useful in collaboratively identifying, and locating additional information sources. Furthermore, approximately three months of full-time work was required to photocopy, scan, and catalogue all secondary data, produce an annotated bibliography and convert into an electronic format for distribution to stakeholders (Blackman *et al.* 2006). This process lent support for the research by aiding institutional strengthening through information exchange and by building working relationships.

Preliminary Stakeholder Assessment

A total of 57 interviews were conducted across 12 islands during May 2006. As a result, stakeholder groups, political, social, and management structures were further characterised including a better understanding of the distribution of MRUs and their resource and space-use patterns. Information gathered during this assessment was also utilised to further define research objectives by including stakeholders' concerns as well as aided the identification of subsequent socio-economic survey variables and appropriate spatial data collection tools.

Basemap Production

Production of a 'topogy' or local name map for each Grenadine island was originally conducted to annotate the simple basemap and increase stakeholder recognition in mapping exercises. The alternative importance of this mapping exercise was realised during the processes of validation and distribution of these 'topogy' maps within each island. This type of map had never been developed in the Grenadine Islands before, and therefore the production and distribution of these maps provided for community discussion and debate, further aiding community knowledge and acceptance of the research.

Socio-economic and Activity Profiles

As a result of posting survey instruments on the MarSIS e-group, some questions were rephrased with local terminology based on feedback from stakeholders. The researchers who administered the surveys believe that these changes aided local relevance and understanding of questions. The series of 13 PM&E meetings (including two government stakeholder meetings) were well attended with a turnout of nearly 200 stakeholders. All stakeholders were pleased that the research team carefully considered and took the time to inform, validate and get feedback from a variety of stakeholders. The ultimate success of these meetings can be attributed to the use of a combination of PR mechanisms. Holding meetings during the early evenings, in convenient locations where the stakeholders felt comfortable (i.e. rum shops, in the streets, fishing camps) was essential. Furthermore, consultation with key informants to find an appropriate time, date and location for each meeting was critical. Additionally, prior to each community meeting, researchers would post flyers, walk the streets, and ask community members to help spread the word.

Coastal/Marine Classification

By participating in interactive learning exercises, the researcher was able to develop friendships, trust, and respect with the various MRUs allowing for stronger working partnerships. By experiencing each type of MRUs daily routine, not only were invaluable insights into each MRU's livelihood and resource space-use patterns gained, but respect and trust were earned. Mutual learning through informal conversation and questioning was also found to be less difficult when the MRUs were working and sharing their daily routine with the researcher. Thus, by participating in interactive learning exercises the identification and cooperation of potential key informants for subsequent participatory mapping exercises was abridged.

Mapping Exercises

Individual mapping exercises were found to be simpler to administer than with focus groups for many reasons. One on one mapping exercises allowed the researcher to ask questions about the information given and a good amount of information was able to be quickly obtained. On the other hand, group mapping exercises took considerably longer amounts of time, yet provided for more quality assurance through the process of peer review. If consensus was not gained, stakeholders were questioned and had to defend their response to the other participants until an agreement was made. Furthermore, care had to be taken by facilitators to make sure that more dominant participants did not take over the mapping exercise and that all participants felt comfortable contributing to the mapping exercise.

DISCUSSION / LESSONS LEARNED

Numerous lessons have been learned and existing knowledge re-affirmed from the utilization of PR in the development of the Grenadines MarSIS.

Geographic Scale and PR

The issue of geographical scale in relation to the appropriateness of using PR in the development of a transboundary PGIS must be critically analysed. Further investigation on the ultimate success of utilising PR across such a large-scale; encompassing two countries, including nine inhabited islands, thirteen communities, and close to a thousand direct marine resource users must be carefully appraised at the conclusion of the research. As a direct result of this, together with the variety of PR mechanisms employed, the research has taken a substantially longer time period than anticipated. The importance of transparency and communication cannot be underestimated. Taking the time to allow stakeholders to understand the research objectives and gain confidence in the researchers, both within each community and amongst the various stakeholders, has been critical in the research thus far. Furthermore, carefully identifying the various stakeholders, each groups' issues, as well as accommodating the interests of the stakeholders' into the objectives of the research from the onset was crucial in gaining participation and support for PR of this scale. Additionally the importance of continual stakeholder validation and evaluation meetings must be emphasised. Although time-consuming, the processes of holding a range of government and communities meetings after each stage of the research; including the distribution of periodic summary/technical reports and maps in combination with the utilisation of the MarSIS e-group for information exchange and open communication, has provided for increased understanding both between and among the various stakeholders. Moreover, support and respect for the researcher and research has been gained by taking time to frequently revisit with stakeholders and personally discuss the results and progress of the research. By consulting with stakeholders before each stage of the research and seeking input as well as allowing for adaptability in PR methodologies has been well received. Furthermore by ensuring that stakeholders periodically validate and give feedback, a sense of control and ownership in the research has been attained. Therefore the process of using PR must be highlighted, and may be as important as the production of the geodatabase itself, particularly in a participatory project of this scale.

Adaptive Research

Allowing for an adaptive research framework has been important to the success of the research. By allowing the researcher and stakeholders to collaboratively evaluate and learn from methodology utilised, stakeholders have helped guide appropriate PR initiatives. Again considerable human resources were needed including: personal visits, phone calls, website surveys, informal and formal meetings in order to find the most appropriate PR methods for use with each stakeholder group and in each island. Moreover, reviewing PR methods to be used with stakeholders in advance and seeking advice from key informants has been essential in choosing feasible PR strategies for each island.

Community Immersion

In order to better understand the use and importance of marine resources as well as gain trust and build working relationships in PR of this scale, it was found that this is best accomplished by the researcher intermittently living within each of the communities'. By participating in interactive learning exercises, not only was a tremendous amount of insight gained on the location of marine resources and habitats, but a better understanding of key issues and struggles in the livelihoods of the Grenadine people was learned. Furthermore, taking the time to 'get to know' each island and its' people has provided insight on the communities' structure, leaders, and resource use patterns which could not have been gained through conventional surveys or short field visits. In turn, by living in the community and participating in community activities, trust and respect for the research and research objectives was earned amongst stakeholders. Again, this process was time intensive but allowed the researcher to gain credibility and provide for mutual learning and understanding between the researcher and communities.

CONCLUSION

This research shows the multi-faceted benefits of utilising of PR mechanisms in the development of the Grenadines MarSIS. This marine resource space-use information system can lay a foundation for a more holistic approach to collaborative trans-boundary marine resource management. Secondarily, through the established communication channels, PR mechanisms, and the adaptive framework of PGIS development, it is hoped that a range of stakeholders' capacities have been strengthened and will foster subsequent engagement in sustainable marine resource planning, development, and management. Ultimately, this PGIS research aims to provide the communities of the Grenadine Islands with an easily accessible integrated information base to support an environment of participation in resource management and decision-making processes as well as strengthen multi-stakeholder communication, education and advocacy.

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