

Using GIS Tools for Participatory Management of Coastal Resources in Laborie Bay, Saint Lucia

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ABSTRACT

The village of Laborie on the south coast of Saint Lucia has been the site of a three-year study to investigate the relationship between people's livelihoods, their involvement in the management of resource use, and the status of the coral reefs in Laborie Bay. The area is typical of many in the region where reefs provide a variety of goods and services, but until recently little information was available on their extent and status. The most recent maps of the reefs were made in the late 19th Century and included only enough detail to identify hazards to navigation. The information that was available on marine resource use was therefore not related to specific geographic areas. This paper describes the selection and application of appropriate GIS tools and methods to integrate popular knowledge and the data from scientific research. It focuses on the need to distinguish between mapping designed to classify habitats for ecological research, and the identification and mapping of features recognized and used by fishing communities and other resource users. Mapping based on local geographic knowledge was found to be essential in the acquisition, redistribution, and analysis of information and in its application in participatory management processes. The transfer of the GIS-based project management tool to a community-managed resource is discussed.

KEY WORDS: GIS, mapping, participation

GIS para el Manejo de Recursos Costeros en la Bahía de Laborie, Santa Lucia

Laborie en la costa sur de Santa Lucia ha sido el sitio de un estudio de tres años que esta investigando la relación entre gente, su participación en el manejo de recursos, y la condición de los arrecifes en la Bahía de Laborie. El área es típica de muchos en la región en que arrecifes proporcionan una variedad de servicios pero hasta recientemente, habia poca información sobre la condición de los recursos. Los mapas más recientes de los arrecifes se hicieron en el siglo XIX e incluyeron sólo suficiente detalle para identificar los peligros a la navegación. Por lo tanto, la información que estaba disponible sobre el uso de recursos marinos no fue relacionado a áreas geográficas específicas. Este manuscrito describe la selección y la aplicación de GIS y métodos de integrar el conocimiento de los que viven en Laborie y datos de estudios científicos. El énfasis del manuscrito es en la necesidad de distinguir

entre la cartografía diseñada para clasificar habitats para investigaciones ecológicas y la identificación de características reconocida y utilizada por los pescadores de las comunidades. La cartografía basada en el conocimiento de los que viven en Laborie se encontró ser esencial en los procesos de manejo. La transferencia de la tecnología de GIS para el manejo de los recursos se discute.

PALABRAS CLAVES: GIS, recursos costeros, Santa Lucia

INTRODUCTION

Laborie is a small village located on the south coast of Saint Lucia. In 2001 a three-year research project was started to investigate the relationship between people's livelihoods, their involvement in resource management, and the status of reef resources (CANARI 2003). The project was entitled *People and the Sea* and aimed to provide guidance towards the identification of alternatives to Marine Protected Areas for the management of coastal resources. The rationale was that while there has been a global emphasis on MPAs in recent years, it is apparent that this approach is not appropriate in all circumstances. Alternative approaches are needed in places where the resource base cannot support the establishment of an MPA, but where those resources are nevertheless critical to people's livelihoods. Laborie was selected because it is representative of Caribbean coastal communities, and it provided an opportunity to study, test, and develop a livelihoods-based approach to management. This approach included the study of participatory institutions to increase stakeholder participation in planning and management, and options to increase economic benefits from activities such as the reef fishery, sea urchin harvesting, seaweed cultivation, and heritage tourism.

Research on reefs in St. Lucia has focused mainly on the west coast, and particularly within the Soufriere Marine Management Area (SMMA). Ongoing activities include monitoring of reef communities, assessment of the effectiveness of fishery reserves, the impact of reserves on fishing communities, and analysis of the participatory process that has been critical to the functioning of the SMMA and is seen as a model for MPAs in the eastern Caribbean.

Much less attention has been given to the south and east coasts, and there was little information available on distribution of reefs in Laborie Bay. The *People and the Sea* was designed and implemented with a high level of stakeholder participation, and it was important therefore to be able to integrate popular knowledge and scientific information. Appropriate tools were needed to facilitate the collection and redistribution of information and to relate the information to features and places recognized and used by the Laborie community.

METHODS

A review of existing documented information on marine habitats in Laborie Bay showed that little was available. As with many islands in the eastern Caribbean, Saint Lucia's reefs have not yet been mapped in any detail, and it was soon evident that there was no recently published information on the distribution of reefs in Laborie Bay. Given that habitat mapping can be a very costly exercise there was a need to make the best use of any existing material, and to build on that using cost-effective methods and equipment. This would involve firstly the collection of existing information of any type and complementing it with data gathered through field surveys and information provided by the Laborie community.

Available background material included the following:

- i) Reproductions of various historical maps with little or no detail of marine features but with some useful background to current popular names,
- ii) Original hand-painted maps from the mid 18th Century indicating soundings, reefs and anchorages,
- iii) Topographic maps at 1:2,500, 1:10,000, 1:25,000 and 1:50,000, the most recent compiled in 1995 from a 1992 aerial survey,
- iv) Navigational charts showing general reef distribution but at a very coarse level of detail, intended only to identify the seaward boundary of reefs as potential navigational hazards and mainly based on 19th Century surveys, and
- v) Aerial photos made for land cartography but including marine features to a distance of approximately 1.25 km from shore, from series made in 1941, 1966, 1977 and 1992.

A suitable GIS application was needed in order to make use of these materials, and to integrate the information to be obtained through habitat surveys and community consultation. The program Map Maker Pro was chosen based on the following criteria:

- i) Ability to exchange spatial data with GIS applications already in use in the country,
- ii) Ability to use both raster and vector formats,
- iii) Ability to calibrate (georeference) raster images using the local grid and datum,
- iv) Affordability,
- v) Ability to use GPS data,
- vi) Ability to convert among raster file formats,
- vii) Availability of these features in one program without the need for add-on modules or third-party software, and
- viii) Potential for use and maintenance by the Laborie community for ongoing development planning and management of reef resources.

The process of mapping reefs and other habitats began by calibrating topographic maps and identifying as much as possible of the marine features from the calibrated airphotos. The next stage was to gather first-hand information from people familiar with the Bay during field trips on the water. To

facilitate this, copies of the airphotos were printed, mounted on card and covered with clear plastic sheet. As the boat captain navigated around the Bay features in the airphotos were annotated on the plastic overlay, to include place names and notes on any locations of particular importance for fishing or other activities. GPS waypoints were saved at key locations to improve the accuracy of mapping and to provide a means of returning to places of interest for further surveying and description of habitats. The information was used to compile thematic maps, using the topographic maps as a base, but in the ongoing process of information exchange the aerial photos were found to be far more effective tool than line-drawn representations of the Bay. People who were not familiar with interpreting either line-drawn maps or aerial views would very easily orient themselves to features in the airphotos despite never previously having had access to such a perspective of their environment. Projected airphotos were used at many of the community meetings during the project, providing a dynamic tool that allowed new information to be added and discussed during the meetings.

The *People and the Sea* project included four experiments, with GIS tools being especially useful in planning and conducting two of them. The first was a study of how increased awareness of, and access to, information on the status, causes, and potential impacts of a water pollution could contribute to a change in behaviour, and to identify the processes by which these changes occur. It was commonly believed in the community that water quality in the Bay had been declining for a number of years, but there were no data available to support this belief. The results of a survey of people's perceptions of the nature and significance of this decline were discussed in community meetings, with projected maps and airphotos used to identify specific locations of concern, to plan an appropriate monitoring activity to generate the necessary data, and to review the data as they became available. The indicators selected for monitoring were the levels of faecal coliform bacteria and benthic community composition.

Coliform levels were determined at stations in the ravines and gullies draining into the Bay, along the shoreline, and on reefs approximately 500 m from shore, using methods consistent with World Health Organisation specifications for detection of faecal coliform bacteria (Robens Institute 1993), as an indicator of sewage pollution.

Benthic community composition was assessed at a number of reef sites using the Reef Check protocol (Reef Check Foundation 2003). The method includes 10 categories of benthos, but public discussion focused on relative cover of live coral and macroalgae. Figure 2 shows results for four reef sites. The increase in live coral and decrease in macroalgal cover with distance from shore, together with the algal species composition at inshore sites, supported the belief that land-based sources of nutrients were affecting the condition of reefs in the Bay. Linking data and underwater photographs to reefs in the GIS aided in discussing the results at community meetings.

The second experiment that benefited from the GIS tools was the investigation of institutional options for the management of the harvest of the edible white spined sea urchin, *Tripneustes vestricosus*, locally known as the sea egg, or *chadon* in Creole. A national management programme was implemented in

Saint Lucia by the Department of Fisheries in 1986, in response to overexploitation and declining stocks (George and Joseph 1994). This was a co-management arrangement based on regular monitoring of stocks and participation of resource users in decisions concerning the annual harvest. This functioned well for a number of years until stocks declined severely in the mid-1990s. The harvest was closed by the Department of Fisheries to allow for stock recovery and was still closed at the time the project began. The annotated airphotos were used in public meetings to identify sites of past importance, to identify suitable locations for monitoring, to record current information and perceptions of the status of stocks, and to discuss the findings with regard to the possibility of resuming the harvest.

RESULTS

The mapping exercise demonstrated that reefs and other features in Laborie Bay (Figure 1) are identified by local names that have been established over a long period of time. They come from a variety of sources, such as the names of fishermen who live nearby, the type of fish caught in the area, or particular wave formations. This information has not previously been documented but proved to be indispensable in any public discussions that needed to refer to specific locations.

The ability to link data from a range of sources to specific reefs greatly enhanced discussion and interpretation during public consultations. This was particularly true of the results from the study of water quality (Figure 2), which would have been less readily understood and accepted without the advantage of GIS tools. The use of projected airphotos of the Bay displaying the distribution of bacterial pollution was a very effective means of sharing the results of monitoring. One indication of this effectiveness was the fact that while the results supported many of the popular perceptions, including the belief that sewage pollution was the main problem, they contradicted the belief that only one part of the village was responsible when results showed the source to be much broader. Access to information and a better understanding of the nature and extent of pollution in the Bay have resulted in local initiatives to reduce sewage pollution through the improvement and expansion of public facilities, and to collaborate with appropriate Government departments in identifying suitable systems for new housing construction in the village.

The ability to gather and redistribute information on the status of the sea urchin stocks in public fora was a critical element in the participatory process of monitoring, redistributing results, and discussing management options before each harvest season. Based on this information, and an agreement on specific conditions, including duration and size limits, the harvest was opened in October 2002. This consultative process has continued under the leadership of the Laborie Fishers and Consumers Cooperative which facilitates data gathering and the communication of management recommendations from the community to the Department of Fisheries.

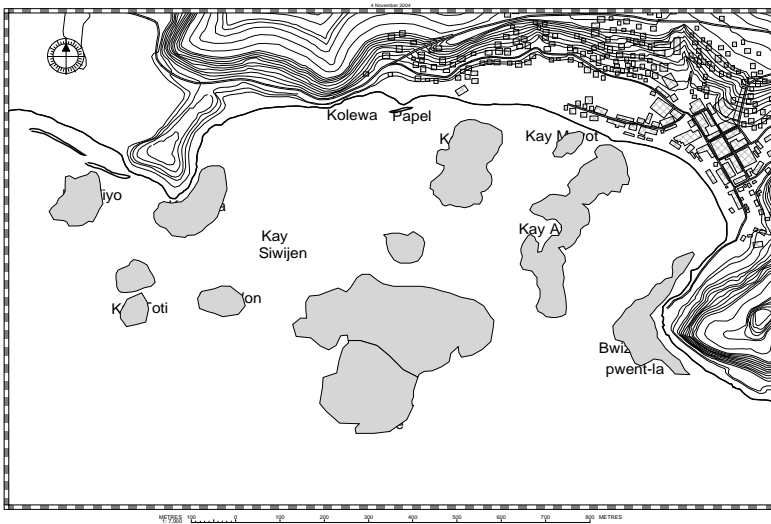


Figure 1. Distribution and names of reefs in Laborie Bay

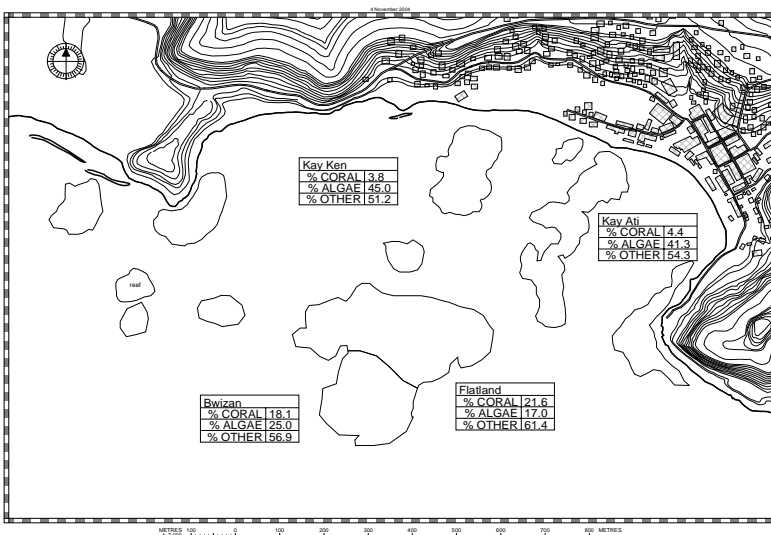


Figure 2. Cover of live coral and macroalgae on two inshore and two offshore reefs in Laborie Bay.

The value of the GIS component of the *People and the Sea* project to ongoing community development has been recognised by local organisations. The Laborie Village Council has provided space for the computer equipment donated to the community by the *People and the Sea* project, and the Laborie Development Foundation has initiated a training programme for teachers and students in mapping and information management in support of a range of planned community development projects.

DISCUSSION

The experience of the *People and the Sea* project has illustrated a number of issues regarding the use of GIS tools in participatory research projects:

- i) The use of GIS tools is appropriate if it adds to the participatory process, and is based on the priority of collecting and disseminating information for collective decision-making.
- ii) Ownership of information collected through a participatory process, including both popular and scientific information may be an important issue. Individuals have the option of not revealing information when it may not be in their own interest, but information gathered collectively may need a collective decision about how it is to be used. Local residents had identified sewage pollution as a primary concern and as a priority for research, and it was initially planned that the results of water quality analysis from Laborie Bay would be widely disseminated. However, it was soon realised that the results could be wrongly interpreted to mean that the condition is unusually severe and specific to Laborie. It was decided by community members that a plan of action to investigate options for reducing sewage pollution should first be developed. The dissemination of information on pollution could then indicate the steps being taken by the community to address a situation that no doubt affects all coastal communities on the island.
- iii) The appropriate GIS tools have great potential to support community initiatives in resource management that typically do not benefit from the centralised GIS systems that exist in most islands. At the same time, the development of local GIS should be compatible with national systems to ensure that information not available elsewhere can be shared and used by centralised systems.
- iv) Mapping aimed at facilitating stakeholder participation in management must identify those features and processes recognized by the resource user community. Habitat mapping based on ecological criteria will have much less meaning than maps based on local names and understanding of the area.

This research project has raised some important questions that are being examined by organisations in the community. In cases where information dissemination can be controversial or damaging, it is essential to determine what could and should be done with the information, who should get it, and in what form.

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