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Rapid Assessment of Management Parameters for Coral Reefs

By
Richard B. Pollnac

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This book was prepared by the Communications Unit of the Coastal Resources Center at the University of Rhode Island: Lesley Squillante, Unit Leader; Chip Young, Editor and Designer; Noëlle F. Lewis, Editor.

This publication is available electronically on the Coastal Resources Center's Worldwide Web site at: http://crc.uri.edu. For more information, contact: Coastal Resources Center, University of Rhode Island, Narragansett Bay Campus, South Ferry Road, Narragansett, RI, 02882 USA; Tel: (401) 874-6224/FAX: (401) 789-4670.

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PREFACE

Coral reefs are a powerful symbol of both the economic and ecological significance of coastal ecosystems, as well as the rapid loss of marine biodiversity, and the resources upon which millions of coastal residents around the world depend.

In 1995, the International Coral Reef Initiative (ICRI) was launched to call attention to the alarming decline of the world's coral reefs and to catalyze a response to reverse current trends. Through regional and global consultative meetings, action strategies were developed that focused on four elements:

- Management
- Capacity building
- Research and monitoring
- Review

Critical to the success of ICRI and efforts to better manage coral reefs and associated marine ecosystems, is the need to track trends of their condition, use and governance. It was recognized early on that while considerable (though not sufficient) effort has been devoted to establishing methodologies for and collecting data on the condition of coral reefs worldwide, there was relatively little work concerning the role of humans in this complex ecosystem.

To address this gap, Project *RAMP* (Rapid Assessment of Management Parameters) was conceived in 1994 as a joint initiative between the Coastal Resources Center of the University of Rhode Island (CRC/URI) and the International Center for Living Aquatic Resources Management (ICLARM), through the United States Agency for International Development/URI Coastal Resources Management Project. *RAMP* was designed to expand upon ICLARM's ongoing work on *ReefBase*, a global database of coral reef condition, by defining for the database a parsimonious set of indicators covering the range of human factors potentially impacting coral reefs.

The results reported in this study represent a major step forward towards establishing such a suite of indicators which, as demonstrated in the two case studies, can be collected in the field. Indicators are defined for context at the national, regional and local levels, as well as for reef uses and reef governance. In all cases guidance is provided as to how to collect and report data.

Project *RAMP* is truly a pioneering effort. As with any such effort, it provides a basis for further discussion, refinement and testing by a broader community of users. In 1996, at the Panama World Congress on Coral Reefs, the Global Coral Reef Monitoring Network (GCRMN) began a process to build upon the work of *RAMP*, as well as the work of other social scientists and community workers, to prepare a GCRMN socioeconomic monitoring manual. The *RAMP* team is a full participant in this important next step in the process of establishing widely accepted and utilized indicators. At the same time, ICLARM and CRC/URI continue to work to incorporate *RAMP* parameters for additional reefs within *ReefBase*.

We would welcome feedback on efforts to utilize *RAMP* and encourage you to submit data resulting from its application to *ReefBase*.

David F. Hales, Deputy Assistant Administrator
Global Environment Center
U.S. Agency for International Development

Lynne Zeitlin Hale, Associate Director
Coastal Resources Center
University of Rhode Island

John McManus
Program Leader, Aquatic Environments Program
Project Leader, *ReefBase* Project
International Center for Living Aquatic Resources Management

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INTRODUCTION

RAPID ASSESSMENT OF MANAGEMENT PARAMETERS FOR CORAL REEFS

While biological and oceanographic parameters form the central part of a database on coral reefs, information concerning human uses and impacts, as well as management efforts are essential to understanding the dynamics involved in changes occurring in this important component of the world ecosystem. As a means of facilitating this important understanding, Project *RAMP* (Rapid Assessment of Management Parameters) was developed to be integrated into the worldwide coral reef database project (*ReefBase*).

Attempts to understand the ecology of coral reefs must account for the behavior of human beings. Humans are one of the major predators of reef fishes in many parts of the world. Humans also cause direct damage to coral by using destructive fishing techniques, improper vessel anchoring and recreational activities, and coral mining for building materials and ornamental uses. Indirect damage is caused by land-based human activities such as deforestation, mining, agriculture and aquaculture, electric power and desalinization plant operation, and waste disposal (both human and industrial) which result in various types of pollution (e.g., nutrient enrichment, sedimentation, poisoning, etc.) having negative impacts on reefs and associated organisms. These coral reef-related human behaviors and their management are intimately related to political, socioeconomic and cultural aspects of populations dependent on, responsible for or somehow impacting the coral reefs under consideration.

The purpose of Project *RAMP* is to provide a parsimonious set of indicators covering the range of human factors potentially impacting coral reefs. Towards this end, aspects of human activities impacting and potentially impacting coral reefs were reviewed in light of developing a guide for information acquisition and subsequent coding for inclusion in *ReefBase*. The review resulted in a set of indicators (Chapter 1) and guidelines for obtaining and coding information on the indicators (Chapter 2). The indicators are organized according to proximity to the designated reef (e.g., national, regional and local), context (political, socioeconomic and cultural), reef uses (fishing, mining, tourism/recreation, etc.) and governance (institutional frameworks, knowledge bases, plans, implementation, monitoring and

evaluation). While all indicators identified are important for understanding human factors associated with reef management, some are more so than others. It is clear that in some cases costs associated (personnel, time and money) with data collection may prohibit obtaining information to assess all indicators; therefore, indicators are classified into categories indicating the degree of importance for the database so that users can decide how to allocate their efforts in data acquisition.

A brief description of some of the indicators included is provided here to illustrate the types of information and its relationship to coral reef governance. For example, at the national level it is important to obtain information on national level variables such as population, population growth, significance of coral reef uses (e.g., products extracted, tourism, etc.), unemployment, literacy, balance of trade, etc. High levels of unemployment combined with rapidly increasing population and pressures on land resources can result in movement into the fishery as employment of last resort, as well as inability to move out of the fishery due to lack of appropriate alternative occupations—all factors influencing overfishing with potentially negative impacts on reef ecosystems. Literacy levels impact employment alternatives as well as ability to receive information concerning reef conservation issues. Low per capita gross domestic product (GDP), political unrest and unfavorable balances of trade can result in environmentally inappropriate decisions regarding governance of reefs.

Indicators from the regional context are also significant. The regional context is the watershed area impacting the reef. In this area it is important to determine land use practices (e.g., farming, industry, forestry, etc.) as well as population, employment, etc. The employment and unemployment indicators, along with regional population and land use, can be used to evaluate the potential for changes in occupation structure resulting from reef management initiatives. For example, one could estimate the regional potential for absorbing labor displaced from a specific sector. If the only sources of livelihood are farming and fishing, and if population pressure on the land is already high, as indicated by agricultural unemployment figures or arable land population density, then management initiatives resulting in displacement of fishers are unlikely to succeed.

Local context includes the onshore area inhabited by reef users as well as the reef itself. Indicators include aspects of reef use (e.g., fishing, mining, tourism, species extracted or used for tourism), local demography and settlement patterns (including population structure, occupations, social and political organization, institutions, etc.). Information on population, occupations and their relationships with reef use are clearly related to management of the resource. Finally, governance indicators (both traditional

and statutory) include use rights, regulations governing all aspects of reef use, as well as aspects of user knowledge of reef resources which are important in understanding existing use patterns and potential reactions to and acceptability of management measures and user educational programs. The complete list of indicators and justifications for each are included in Chapter 1.

The indicators and guidelines were subjected to two field tests in 1995 to determine their applicability to "real-world" information acquisition situations. Locations included a coral reef area in the Philippines with growing fishing pressure as well as incipient tourism, and an overfished area in Jamaica with extensive and growing tourist, industrial and population pressures (Chapters 3 and 4). Further testing has begun in an area in the Philippines with extensive tourist pressures. Lessons learned in these applications were used to modify the original drafts on indicators and guidelines for data acquisition. These guidelines were edited and published as part of the *RAMP* subsection of *ReefBase* to accompany those used for the biological and oceanographic data acquisition and coding methods which will be used by *ReefBase* contributors and coders (*ReefBase* 1997).

This information, both *RAMP* and *ReefBase*, will provide a baseline for monitoring changes in coral reef ecosystems as well as a database for exploring interrelationships between variables included. The importance of defining and recording a standardized set of indicators cannot be overemphasized. At present the coastal zone and fisheries management literature is characterized by case studies, conducted by many different individuals, with unknown biases and varying research methodologies and disciplinary perspectives. When sufficient cases have been entered into these data sets, *ReefBase* with *RAMP* indicators will enable multivariate, quantitative analysis. Independent (e.g., predictor) variables can be related to important dependent variables such as reef health or management institution status to determine the amount of variance attributable to the independent variables. In individual cases, *ReefBase* with *RAMP* indicators will provide a baseline that will facilitate monitoring of the total coral reef ecosystem (including humans) to determine impacts of specific management actions and other changes. Results of these analyses will provide decisionmakers with information that can be used to select alternative courses of action which will be based on more than the currently available unsystematic, anecdotal information.

Earlier versions of Chapters 1 and 2 of this report were included in the final report on *ReefBase* which was submitted to the European Commission in September 1995 (McManus and Ablan 1995). The beta tester version of *ReefBase* was released in February 1996 (McManus 1996), and *ReefBase* Version 1.0, including the *RAMP* subsystem was released in June 1996

(ReefBase 1996). Thus, the International Year of the Reef was recognized, in part, with a database on coral reefs which includes humans as an important aspect of reef ecology. Finally, *ReefBase* Version 2.0 was released in June 1997 (ReefBase 1997). Version 3.0 is now being prepared for release.

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1

INDICATORS FOR ASSESSING HUMAN FACTORS

Richard B. Pollnac

INTRODUCTION

Attempts to understand the ecology of coral reefs must account for the behavior of human beings. Humans are one of the major predators of reef fishes in many parts of the world. Humans also cause direct damage to coral by using destructive fishing techniques, improper vessel anchoring and recreational activities, and coral mining for building materials and ornamental uses. Indirect damage is caused by land-based human activities such as deforestation, mining, agriculture and aquaculture, electric power and desalinization plant operation, and waste disposal (both human and industrial) which result in various types of pollution (e.g., nutrient enrichment, sedimentation, poisoning, etc.) having negative impacts on reefs and associated organisms (cf. Sorokin 1993; Wells 1993). These coral reef-related human behaviors and their management are intimately related to political, socioeconomic and cultural aspects of populations dependent on, responsible for or somehow impacting the coral reefs under consideration.

The purpose of this document is to present a parsimonious set of indicators of coral reef related human behaviors as well as related political, socioeconomic and cultural variables which can be used to assess, predict and potentially manage these behaviors. This set of human factor indicators will be appended to the non-human components of a global coral reef database (*ReefBase*) which is available, on a worldwide basis, to decisionmakers, scientists, environmentalists, etc. (ReefBase 1997).

The importance of defining and recording a standardized set of indicators cannot be overemphasized. At present the coastal zone and fisheries management literature is characterized by case studies, conducted by many different individuals, with unknown biases and varying research methodologies and disciplinary perspectives. Numerous attempts have been made to summarize such case studies, fitting them into general theoretical frameworks from the social sciences (e.g., R. Pomeroy 1994; White et al. 1994; Ostrom

1990; McGoodwin 1990; Pinkerton 1989a); nevertheless, decisionmakers are still faced with a bewildering array of allegedly crucial factors, with no way of evaluating their relative importance or interrelationships (Pollnac 1994). It is clear that systematic, quantitative research is needed to provide a solution to this problem. Given the fact that existing case studies are not strictly comparable (e.g., one may emphasize variable X as an important factor in successful management, while some others make no mention of variable X; is it present or absent?), we are not at the stage where such research can be accomplished.

ReefBase with *RAMP* indicators will enable multivariate, quantitative analysis. Once sufficient cases have been entered into these data sets, independent (e.g., predictor) variables can be related to important dependent variables such as reef health or management institution status to determine the amount of variance attributable to the independent variables.[1] Results of these analyses will provide decisionmakers with information that can be used to select alternative courses of action which will be based on more than the currently available unsystematic, anecdotal information.

Although this type of multivariate analysis can begin after sufficient cases are entered into *ReefBase*, it is important to note that much of the information entered into the data set will be from secondary information, not generated with field research conducted under similar guidelines. Hence, problems of comparability between research methodologies (e.g., operationalization of variables including levels of measurement, sampling procedures, etc.) will reduce the amount of information available for analysis. In all cases, the goal will be to enter data at the most precise level of measurement appropriate to the variable under consideration to facilitate statistical analyses. It is understood, however, that availability of information or funds to gather information may result in varying levels of precision. Hence, the database must accommodate different levels of measurement and provide indicators of the methods used to facilitate appropriate interpretation of the data (for details see Chapter 2). For example, if the researcher wants to maximize sample size, it might be necessary to convert all cases of a given variable to the lowest level of measurement for that variable in the data set.

The indicators, along with justification, data acquisition and analysis methods, are presented in following sections. The indicators are organized according to proximity to the designated reef (e.g., national, regional and local), context (political, socioeconomic and cultural), reef uses (fishing, mining, tourism/recreation, etc.) and governance (institutional frameworks, knowledge bases, plans, implementation, monitoring and evaluation). While all indicators identified are important for understanding human factors associated with reef management, some are more so than others. It is clear

that in some cases costs associated (personnel, time, money) with data collection may prohibit obtaining information to assess all indicators; therefore, indicators are classified into three categories: 1) minimal data set (indicated by two asterisks); 2) sub-optimal data set (one or two asterisks); and 3) optimal data set (none, one and two asterisks). Methods used to obtain information concerning indicators can also vary depending on resources; hence, in *ReefBase*, indicators will be annotated according to source and level of measurement. Where information is obtained from existing literature, it is important that sources be somehow evaluated so that users of the database can make decisions as to its completeness and credibility (Katzer et al. 1982). This issue is more thoroughly discussed in the guidelines (see Chapter 2).

CONTEXT

Contextual indicators will be determined for three levels of proximity to the reef in question: 1) National, indicating the nation state with jurisdiction over the reef; 2) Regional, indicating the watershed area with outflow potentially impacting the reef; and 3) Local, indicating the area of coastal populations directly impacting the reef ecosystems through fishing, mining or tourist/recreational activities.

National Context

The national context is defined as the nation state that has jurisdiction over the reef in question. In cases where two or more nation states share jurisdiction over the reef area, jurisdictions will be defined and indicator data from all involved nation states will be obtained.

Justification. The nation state provides a context which, in part, has an influence on human behaviors impacting reefs under its jurisdiction. For example, high levels of unemployment combined with rapidly increasing population and pressures on land resources can result in movement into the fishery as employment of last resort, as well as inability to move out of the fishery due to lack of appropriate alternative occupations. All these factors influence Malthusian overfishing (Pauly 1994; Pauly et al. 1989) with potentially negative impacts on reef ecosystems. Likewise, current population pressures on land and sea resources and employment patterns can be used to predict or explain reactions to reef management efforts. Additionally, with respect to population, increases in nutrification associated with human

population concentrations can damage reefs tens to hundreds of kilometers distant from the source (Birkeland 1997). Literacy levels impact employment alternatives as well as ability to receive information concerning reef conservation issues. Finally, low per capita gross domestic product (GDP), political unrest and unfavorable balances of trade combined with global markets for reef or reef-related resources can result in environmentally inappropriate decisions regarding governance of reefs. Poverty is perhaps the most basic of these indicators. Clark (1991) has noted the incompatibility between poverty and sustainable development. Poverty results in a situation where immediate access to a resource such as a coral reef becomes more important than future declines.

The interrelationships between many of the national-level variables indicated above and pressure on natural resources, such as coral reefs, are relatively complex (Wiens 1962). Hodgson and Dixon (1988) present information which can be used to illustrate the relationship between some of these national-level indicators and governmental priorities impacting decisions influencing anthropogenic reef stress. According to Hodgson and Dixon (1988), in 1980 wood products in the Philippines contributed to more than 8 percent of export value in contrast to less than 1 percent contributed by fishery exports. Fisheries, however, accounted for about 5 percent of the workforce compared to only 1 percent in lumber and wood processing. Wages are similar in both industries, hence the share of industry revenue going to fisheries workers exceeds that of the logging industry. This led them to conclude that the short-term gains from logging are less equitably distributed than the longer-term gains from the fishery and tourism. According to data presented in the study, runoff from logging would have a negative impact on both the fishery and tourism, resulting in less gross revenue over a 10-year period than that obtained if logging were banned. This analysis suggests that a government decision based on a short-term need for foreign exchange would not only reduce long-term revenue, but would result in increased inequality. Hence, information concerning income distribution and balance of trade would be useful in understanding reactions of government to efforts to reduce reef pollution by controlling logging.

Data acquisition and analysis. Sources for national context indicators can be United Nations or World Bank statistics, national statistics, etc. Sources should be indicated along with data. Fishery data is extremely difficult to obtain, especially in developing countries; hence, those compiling data for *ReefBase* should make some attempt to judge the reliability of fishery statistics wherever possible.

Obtaining data concerning coastal population and population density

NATIONAL CONTEXT INDICATORS[2]

*Population (millions)***
*Coastal population***
*Population growth rate (%)***
*Coastal population growth rate***
Adult literacy rate by gender
*Per capita GDP (US$)***
*Average annual GDP growth rate (%)***
Annual inflation rate (%)
Balance of trade (US$)
*National unemployment rate (%)***
*Coastal unemployment rate (%)***
*Value of coastal tourism (US$)***
*10-year trend in coastal tourism***
*Number of fishers***
*10-year trend in fisher employment***
*Value of fishery exports (US$)**
*Value of fishery landings (US$)**
*10-year trend in fishery landings***
*Value of reef related products (US$; %GDP)***
*Value of reef related exports (US$; %GDP)***
*10-year trend in reef related products***
*10-year trend in reef related exports***
*Total arable land area (sq km)**
Total land area (sq km)
*Length of coastline (km)***
*Total reef area (sq km)***
Population density: land, arable land, coas*tal**, reef**

can also be problematic. In cases where statistics concerning coastal populations are published, the criteria for the categorization must be entered into the database. Where the category 'coastal' is not used, it may be necessary to calculate coastal population from published statistics by summing populations of 'coastal' political divisions for which population data is published. For example, in the Philippines, Fox (1986) calculated number of fishers per kilometer of coastline using figures concerning full-time fishers derived from population census data for coastal municipalities. These figures were cross-checked by visual counts of actual fishers on the water at project locations, and a close correspondence was found. Coastal population density

could be calculated using the same approach. In some cases the political divisions for which population data is available may be so large as to make the figures unreliable as a measure of coastal population density. A national map outlining the 'coastal' political divisions used in calculating the coastal population figure may help users evaluate the usefulness of the indicator as well as other indicators derived from this figure (e.g., coastal population density).

Regional Context

Regional context should encompass the region including the watershed with effluent potentially impacting the reef. This region can frequently be determined using available information such as land use maps. If not, assistance of regional natural resource officials may be required.

Justification. Land-based human activities have been indicated as sources of factors influencing the health of reefs. For example, increases in sedimentation and runoff as a consequence of coastal and watershed development associated with rapidly increasing population densities are said to pose more immediate threats to the health of coral reefs than global effects such as ozone depletion or enhanced greenhouse effects (Muller-Parker and D'Elia 1997). Based on a literature review, Birkeland (1997) reports that the greatest threats to coral reefs are usually considered to be sediments and accompanying nutrients. In a study conducted at the northern tip of Palawan in the Philippines in the mid-1980s, it was found that erosion from cut forests and logging roads combined was 240 times as great as uncut forest with roads accounting for 84 percent of the erosion. Additionally, loss of live coral cover was significantly correlated with mean sediment deposition (Hodgson 1997). The contextual indicators provide some indication of the extent of these types of activities and their relative importance in terms of local employment.

The employment and unemployment indicators, along with regional population, can be used to evaluate the potential for changes in occupation structure resulting from reef management initiatives. For example, one could estimate the regional potential for absorbing labor displaced from a specific sector. If the only sources of livelihood are farming and fishing, and if population pressure on the land is already high, as indicated by agricultural unemployment figures or arable land population density, then management initiatives resulting in displacement of fishers are unlikely to succeed (Pauly et al. 1989).

REGIONAL CONTEXT INDICATORS

*Total size of watersheds (sq km)***
*Land use in watersheds (%)***
- *Undeveloped*
- *Residential/built-up*
- *Forest*
- *Mining*
- *Agriculture*
- *Industry (% by type)*

*Population, population density***
*Employment/unemployment by major categories***
- *Agriculture*
- *Forestry*
- *Mining*
- *Fisheries*
- *Industry*

*Unemployment rate (%)***

Data acquisition and analysis. Since availability, scope and reliability of regional context indicators will vary widely across nations, as well as regions within nations, sources and methods for these indicators should be clearly specified. For example, some data (e.g., amount of land devoted to agriculture, population, etc.) may only be available on a 'county' (or some other local political division) basis, and the watershed is only a part of this division. A note should be appended that the statistics apply to a division that includes the watershed which is a specified percentage of the total land area.

Local Context

The definition of local context is open to debate, but it is essential to arrive at some closure to insure comparability of data from different locations. For purposes of this database it is suggested that local context includes the area of coastal populations directly impacting reef ecosystems through fishing, mining or tourist/recreational activities. Local context should also include all communities directly onshore from the reef or within three hours sailing time. Obtaining data for local context indicators is more complex than the previous levels; hence, more detailed instructions and justification will follow the list of indicators.

LOCAL CONTEXT INDICATORS

*Services/facilities (roads, schools, sewers, etc.)**
*Banking services***
*Number and sizes of local communities***
*Political organization***
*Occupation structure (occupations, occupational mobility, alternative occupations, unemployment, sexual distribution of labor, etc.)***
*Population/population changes (natural/migration)***
*Population per km of coastline***
*Number of fishers***
*Population per km sq of local reef***
*Social structure (homogeneity, distribution of wealth)**
*Quality of life***

Justification. Indicators included in the local context are those that have direct impact on behaviors of individuals exploiting reef resources. These indicators will provide some indication of actual and potential pressures on reef resources, contextual variables potentially impacting design of reef management strategies, as well as factors influencing behaviors of reef users (e.g., alternative income opportunities). Due to the internal complexity of some of these variables, further justification will be provided, as appropriate, along with discussion of data collection methods below.

Data acquisition and analysis. Because of the complexity of some of the local context indicators, methods for each will be described separately.

Services and facilities. This indicator will be used as a general measure of local community development, as well as providing information essential to determining sources of some anthropogenic impacts on the reef (e.g., sewage treatment). The list should include the following items: hospital, medical clinic, resident doctor, resident dentist, secondary school, primary school, religious institution (e.g., church, mosque, temple), public water supply piped to homes, sewer pipes or canal, sewage treatment plant, septic or settling tanks, electric service, telephone service, food market, drugstore, hotel or inn, restaurant, gas station, public transportation and hard-top road access. This data should be collected by observation and key informant interviews in the local communities.

Lists like the above have been widely applied as gross indicators of level of community development (cf. Young and Fujimoto 1965; Graves et al. 1969). While several scaling techniques (e.g., Guttman scaling, factor analysis; Pollnac et al. 1991; Graves et al. 1969) have been used to evaluate and give summary scores to such lists, it will be sufficient to merely count the number of items present in each community in the local context and provide summary statistics (e.g., range, mode, median, mean, standard deviation).[3]

Banking services. Banking services are an important predictor of availability of credit for development changes that may be associated with the exploitation and/or management of the reef. This indicator can be determined from local key informants or community walk through. Banking services will be considered present if they are found as near as a trade center frequented by most community members on at least a weekly basis.

Number and sizes of local communities. Several studies have suggested that local resource management efforts are most likely to be successful in relatively small communities (Anderson 1994; White 1988, 1989); hence, some indication of community population is desirable. Local population can also be used to construct indicators concerning pressure on reef resources. Techniques used to assess this indicator depend on availability of reliable, detailed maps and population statistics. Where available, a map can be used to identify communities within the area designated as the local context, and populations can be determined from national, regional or local statistics. Source and date for population statistics should be identified and entered in the data set. Ideally, the secondary information (number and size of communities) should be evaluated by travel through the local area and interviews with local key informants.

Population and population changes. This indicator is used to give a gross indication of population pressure on reef resources. Direction of change along with an evaluation of migration patterns and alternative occupations (local, regional and national) can indicate potential for Malthusian overfishing.

The idea of population pressure resulting in destructive over-exploitation of a resource need not be applied only to the fishery. There must also be cases where as local populations grow, uses other than fishing (e.g., tourism) are pushed to grow to provide employment and income for the ever expanding population. Like in the fishery, this would destroy the natural resource based tourist potential, through accumulation of too many hotels, etc. Periods of population changes, whether as a result of growth or in-migration, have also

been related to difficulties in continuity of community-based resource management systems (McGoodwin 1994; Pollnac 1994).

Sources for population, population change and migration data are the same secondary sources used for community population data. Local context population would merely be a summation of the community data.

Reef population density per square kilometer. This provides a gross indication of pressure on reef resources. It is calculated by dividing total reef area into local context population.

Political organization. This indicator involves evaluation of the number of various levels of political organization within the local context. The number of higher level political divisions within a local context will probably be directly related to potential for conflict in governance. For example, there is a greater chance for consensus if the local context includes 20 villages in one township, than if the 20 villages were divided among three townships (Pollnac and Sihombing 1996). Key informants can provide this type of data.

Occupational structure. This indicator puts the reef in part of its economic context. It facilitates evaluation of the relative importance of the reef in terms of the livelihood of individuals living in the local context. For example, information included in this indicator can be used to determine the proportion of the local population dependent on the reef for income as well as alternative job potentials if reef management impacts the existing occupational structure.

There are several sources of data for determining distribution of occupations in the local context. In some cases, local political or religious officials keep records concerning employment. This secondary data can be used, but it must be used with care in a rural or developing country context. It has been noted that a high degree of occupational multiplicity is characteristic of coastal areas (Pollnac et al. 1994), and official statistics frequently mention only principal occupation. Hence, if secondary data is used, it is best if followed-up with key informant interviews in the local context. Key informants, representative of occupations noted in the statistics, should be asked if they, or others in the same occupation, are involved at any extent in other productive activities.

If secondary data is unavailable, the minimum acceptable data source would be based on a series of interviews with key informants representative of different occupations present. For example, one may first approach a local individual who is likely to have some basic knowledge of local productive activities; e.g., a school teacher, the mayor, a feed store owner, etc. This type

of key informant could give basic information concerning types and relative proportions. This type of key informant could also identify representatives of the types. Several representatives of each type could then be interviewed as a cross-check on relative proportions, as well as for obtaining information on part-time activities, unemployment, alternative occupations and sex/age distribution of labor. Ideally, in cases where no secondary data is available, information on occupation structure could be obtained as a part of a community survey.

Social structure. An important characteristic of the social structure is the distribution of wealth, a rough measure of which can be based on occupation structure and incomes by occupation type. Numerous researchers have commented on the incompatibility of economic poverty and sustainable development in general (e.g., Clark 1991), and sustainable reef resource use in particular (White et al. 1994). Hence, occupational categories and subcategories classified as to income and proportion of population and compared with nationally set poverty levels can be an important indicator of potential for sustainable development.

Another important aspect of social structure is the degree of population homogeneity or heterogeneity. Local contexts can be occupationally, economically, ethnically, or religiously homogeneous or heterogeneous, and several researchers have related group homogeneity to degree of success in group efforts associated with marine resource management (White et al. 1994; Pollnac 1994; Pinkerton 1989b; Jentoft 1989). This indicator is based on intra-community distribution of income, occupations, religion and ethnicity.

Quality of life. A traditional indicator of quality of life is infant mortality rate. This is a fairly good measure of general nutrition and health care, indicators concerning satisfaction of some basic human needs. Newland (1981:5) writes that "no cold statistic expresses more eloquently the differences between a society of sufficiency and a society of deprivation than the infant mortality rate." Secondary sources might provide this information for the local context, but it is most likely aggregated for some larger area. Regional health services may have the disaggregated data which could be used to calculate an index for the local context. At least a five-year series of data should be used.

If this data is not available, it has been suggested that it is possible to provide a gross evaluation of basic well being by looking for signs of under- or malnutrition, disease, infections or skin conditions among children (Townsley 1993). The minimal evaluation would be an ordinal ranking of living conditions on a scale of from one to five (for example). This ranking

could be accomplished by someone familiar with local living conditions, such as a local social worker or government official concerned with welfare issues. The exact measure used should be indicated in the database.

REEF USES

Reef use indicators will provide direct indicators of specific impacts on reef organisms. Uses will include harvesting of organisms (including the coral itself) and tourism. The local fishery adjacent to the coral area also needs to be assessed since coral fish, etc. are often captured away from the reef, and relative dependence on coral species needs to be determined to assess impacts of management efforts.

CORAL REEF USE INDICATORS

Local reef nomenclature (local terms used to refer to the identified reef and its subunits along with mapping as perceived by local users)

*Ten most important flora and fauna harvested or mined by type (folk and scientific taxonomies) and use***
For each type:
-Methods (type, when, where)
-Participants (social positions, numbers)
-Importance (amount/value)
-Post-harvest distribution (e.g., subsistence, market (local, regional, national, export))

*Types of reef tourism/recreation***
For each type:
-Support services (e.g., dive shops, hotels, guides)
-Participants (social positions, numbers)
-Importance (amount, value)

Justification. Information concerning names of the reef and its various features and sections is important for identification of locations of various resources used, as well as providing some indication of local perceptions of the reef which may differ from 'objective' mapping. Further, Johannes (1997)

suggests that maps with local place names (e.g., fishing spots, reefs, etc.) can be the first step in resource mapping with use of local knowledge. Such maps can play an important role in environmental impact assessments in reef areas. Information concerning target species and fishing pressure can provide indicators of potential reef problems. For example, Birkeland (1997) points out how removal of key predators of coral grazing invertebrates can result in their expanding beyond available food resources. Removal of algae grazers can also result in increases in coral-smothering algae (Birkeland 1997; Hughes 1994). Glynn (1997) reports that overfished reefs lead to a dominance of sea urchins which is reportedly negatively correlated with live coral cover. He indicates that "sea urchins are the only echinoderms capable of significant bioerosion" (1997:84).

Identification of markets for products is an important indicator of factors influencing both pressure and potential pressure on resources. Level of commercialization, especially global markets for products, have been identified as having negative impacts on traditional marine resource management in general (Pollnac 1984, 1994), as well as coral reef management practices (White et al. 1994). It therefore follows that knowledge of existing, exploited resources in combination with potential markets (especially global) and levels of local poverty can be a powerful set of indicators suggesting potential for overexploitation.[4] All other indicators listed above concern direct human impacts on the reef ecosystem; therefore, no further justification is needed.

Data acquisition and analysis. Local reef nomenclature refers to local names for the reef, its sections and features. It will include place names as well as general terms used to label features. These terms and names can be obtained from local users (e.g., fishers, tourism/recreation business operators). Multi-method techniques can be used to elicit the terms and names. Users, for example fishers, can be asked where they deploy their gear. The first response from a reef fisher is likely to be a general term for the reef. The user can then be requested to provide a more precise location, which might elicit a name for a specific part of the reef. Step-wise questions such as these directed at different user types will result in a hierarchically organized set of names for reef locations and features. Additionally, the researcher should go out on the water with fishers, asking for the names of all features in the local area. Once the fishers fully understand what the researcher is trying to learn, most features can be named and mapped. Where users are familiar with maps, a chart of the reef can be used to elicit locations of named areas as well as facilitating acquisition of a complete list of names (e.g., users can be asked if there are names for as-yet- unnamed areas on the chart). Users can also be requested to draw their own map of the reef, a technique which may elicit

further place and feature names. Names elicited with the use of maps should be verified by visiting the locations with key informants.

Several techniques can be used for determining important types of flora and fauna harvested. The simplest is the use of secondary information where available. Many countries collect some form of fisheries statistics, and these should be reviewed as a potential source of information concerning the indicators listed under the first major category in this section. Since fishery statistics are notoriously difficult to collect, secondary sources should be evaluated, if possible. If data for this category is based only on available secondary information, this should be noted in the database entry, and evaluations of the information should be included. Evaluations can be based on several criteria: 1) a brief description of data collection methods and frequency; 2) a description of data collectors, compilers and analysts (e.g., number, qualifications); 3) an evaluation of the quality of the information made by a competent key informant such as national university personnel or international experts familiar with the system of data collection used; and 4) interviews with local buyers and distributors, and in local markets concerning the types and amounts of flora and fauna channeled through the marketing and distribution system. The type of evaluation of secondary information should be entered in the database.

The fourth type of evaluation listed above overlaps with primary information data collection methods–the use of key informants in local communities. One way of obtaining information on the indicators is by interviewing local key informants such as buyers and distributors of reef products. These key informants can be used to obtain information on the indicators as well as identify producers for further interviews to cross-check information obtained in addition to providing additional information on the indicators. Once producers have been identified, either through key informant interviews or observation, the following information should be obtained:

1. Lists of the 10 most important coral reef vertebrates, coral reef invertebrates, non-coral reef vertebrates, non-coral reef invertebrates by use (home consumption and income) listed by both local and scientific names (if someone with knowledge of scientific taxonomies is not available, photographs should be taken for later identification).

2. For each important resource:

-**Who**: Specifically, who in the household exploits the resource?
-**When**: Time of year, month, moon, tide, day, etc. How much time spent exploiting this resource?

-**Where**: Where is the resource gathered? What are the use rights?
-**How much**: Quantity of resource gathered on a good day, typical day and poor day.
-**Why**: What is the resource gathered for? Household consumption? Selling in the market? (How much to each use?)
-**How**: How is the resource gathered (equipment, methods)? Source of equipment (if any)? Source of spare parts, maintenance, fuel (if needed)?
-**How**: How is the resource distributed? (If sold, how is it sold? When, where, to whom?) If traded, how? (For what, when, where, & with whom?) If given to kinsmen or other families, is it reciprocal (e.g., if I give you some today, will you give me some when I'm too tired or sick or unlucky?)?

Reef tourism and recreation indicators can also be obtained from secondary information. Most regions with tourism have governmental departments or divisions responsible for regulating and keeping information on tourism. Additionally, communities with tourist attractions often keep information concerning facilities and numbers. A review of this type of information can be used to determine the indicators, but some community-level evaluation of the secondary data should be conducted, if possible. If secondary information is used, the date of the information as well as source and evaluation, if any, should be entered in the database.

Ideally, key informant interviews and observation should be used to evaluate as well as supplement the secondary data. A walk through the community could be used to identify tourist facilities. Facility operators can be interviewed to obtain information on the other indicators.

REEF GOVERNANCE

Reef governance indicators range from local to national levels. The governance indicators include knowledge concerning coral reefs, use rights, management efforts (traditional, local, and national), as well as the local and national institutional governance settings.

Justification. All of the indicators included in the reef governance category have direct relevance to understanding existing, as well as potential management efforts. For example, ecological knowledge of users is a factor increasingly recognized as both influencing receptivity to and providing information significant for governance (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Felt 1994; Johannes 1981), use rights and actual management efforts (traditional and/or official), if any. Local ecological knowledge is related to reef governance in several important ways. First, local knowledge

concerning the reef and its associated flora and fauna can contribute to the scientific understanding of this complex ecosystem. Second, an understanding of local knowledge systems can facilitate interactions between reef users and outsiders (e.g., scientists, management specialists, decisionmakers, etc.) concerned with reef issues. Third, knowledge of local belief systems concerning human relationships with reef flora and fauna may help predict and explain reactions to management efforts. We will briefly examine each of these important factors.

First, local knowledge (ethnoscience) of reef ecosystems has been gained through centuries of intimate interaction and observation by people who depend on this resource for food and other products. To them, this knowledge is closely connected with their very survival; hence, the detailed accuracy of their observations form part of their cultural adaptation to this complex ecosystem which has been transmitted and elaborated through the generations. For the Pacific region, Johannes (1981) cites a number of scientific observers commenting on the richness of local knowledge of reef ecosystems. Perhaps the most convincing testimonial to the usefulness of this type of information is provided by the noted marine scientist Robert Johannes who writes,

> *...I gained more new (to marine science) information during sixteen months of fieldwork using this approach than I had during the previous fifteen years using more conventional research techniques. This is because of my access to a store of unrecorded knowledge gathered by highly motivated observers over a period of centuries.* - (Johannes 1981:x)

Johannes (1981) notes, of course, that this type of information must be quantified and complemented by more sophisticated forms of biological ecosystem research to optimize its usefulness. Other observers (e.g., Wilson et al. 1994) have noted that attention to this type of ecosystem detail may be essential to the effective management of the complex and possibly chaotic nature of multi-species fisheries.

Second, it is obvious that marine scientists and managers can lose credibility with users of marine resources if they do not know at least as much about the resource as the users themselves; hence, impeding effective interaction. Given the above quotation from Johannes, this should give pause to 'experts' who assume that their scientific knowledge gives them the right to move into a situation and immediately assert their superiority by telling local users about a resource they have been using for generations. This was clearly demonstrated in the early days of the Fishery Conservation and Management Act in the United States when fresh, young fishery biologists

from the National Marine Fisheries Service would conduct local meetings, lecturing to experienced fishers who, in some cases, knew more about some aspects of the behavior of the target species than the lecturer. As a consequence, scientists lost credibility which was difficult to regain. Comments like "I ain't gonna have no schoolboy who's afraid to go out in water over his knees tell me about fish!" were commonly heard on New England fishing docks, and many fishers ceased attending the information meetings. Hence, knowing at least what the resource users know will help the scientist maintain the credibility necessary for effective interaction.

Additionally, part of this local knowledge is a taxonomy of the reef and its resources. Knowing these names will facilitate accurate communication and data acquisition. For example, in one region where the author worked, local fishers refer to a single species with two distinct names, reflecting different stages in the growth cycle–one name for the young, small fish and another for the older, larger fish, both of which appear in catches and the market. This distinction is not noted in either the Spanish dictionary or an accepted list of fish names in Spanish–it is a local variation. This information was crucial for a team of biologists and economists who were setting up length-frequency and catch-effort data collection schemes. Raymond Firth, an anthropologist with extensive experience in fishing communities, reinforces our assertion concerning the importance of knowledge of the technical language in the local area. He writes that,

> *...furnished with the right word, one can get a direct answer to a question or understand a situation at once; without it, however correct one's speech may be grammatically, one may often puzzle one's informant or be reduced to giving and receiving laborious explanations which often irritate the person one is talking to.* - (Firth 1966:358)

User beliefs about reef resources is also an important aspect of governance. Understanding how users' beliefs about the resource differ from the scientists' or managers' may help predict and explain reactions to management efforts. For example, Zerner (1994), discussing beliefs of Mollucan fishers, notes that they believe the marine world includes spirits that can either bring fish to their nets or cause the fish to stay away or disappear. The actions of these spirits depend on the quality of fishers' social interactions with the spirit community. Hence, catch depends on these relationships, not some scientifically based analysis of the resource. It would thus be difficult to convince such a community of fishers that their fishing activities would have any impact on their ability to catch fish. A lack of fish would be

REEF GOVERNANCE INDICATORS

Ecological knowledge of users:
*-Folk taxonomies of reef resources***
*-Beliefs about and uses of (all) or (important**) items in taxonomies*
-Perceptions of changes in resource
-Variation in ecological knowledge

Jurisdiction (what political entities have jurisdiction over the reef)

Use rights:
-Types (open, common, group exclusive, private)
-Boundary distinctness
-Transferability
-Surveillance & enforcement (e.g., how do those with jurisdiction or use rights monitor users [e.g., post guards, patrol the area by boat, deploy spirits] and how do they punish violators [e.g., fines, jail terms, social or physical banishment, supernatural sanctions])

Management efforts:
-Types (e.g., what, how, who, impact?)
This would involve a description of the existing management system (if one exists). The key questions, in brief, are:
- *-Date of implementation*
- *-What (e.g., what species, what activity, etc.),*
- *-How (e.g., protected areas; regulation of reef resource exploitation, management of tourism activities, management of land-based activities & coastal development, active reef restoration, etc.)*
- *-Who (central authority, co-management, community management, etc.)*
- *-Extent of user input*
- *-Surveillance and enforcement (as described above under use rights)*
- *- Total administrative cost*
- *- Impact (an assessment of the effectiveness of the effort)*

attributed to incorrect relations with the spirits, not too much fishing effort. Knowing this in advance would allow managers to prepare for resistance to scientifically based rationales for management. This preparation could take the form of training sessions which would introduce the scientific evidence in a culturally appropriate manner.

Local perceptions of changes in a resource also seem to be important in development of management efforts. It has been noted that a perceived crisis in stock depletion on the part of fishers and government is a favorable precondition to successful co-management in fisheries (Pinkerton 1989b).

National and local governance setting indicators are justified by the fact that they influence the development, implementation, monitoring and enforcement of management efforts. Descriptions of use rights are fundamental to evaluating existing or potential management efforts. Numerous researchers have related territoriality to success in management efforts (Pinkerton 1989b, 1994; Pollnac 1994; White et al. 1994). Caroline Pomeroy supports these findings, writing that "boundaries enhance fishers' sense of control over the shared resource and the likelihood that they will work to sustain its use over the long term" (1994:37).[5] Finally, description and assessment of existing management efforts (both traditional and statutory) provides a benchmark for assessing degree of control over the role of humans in the reef ecology as well as information alleged to be essential to development of appropriate management schemes (cf. Pollnac 1994; Pinkerton 1989b, 1994).

Data acquisition and analysis. Ecological knowledge of users can be obtained using ethnographic interview techniques (see Spradley 1969). The first step in acquisition of this type of information involves constructing folk taxonomies of reef resources.[6] Folk taxonomies are best generated using a small group of experienced fishers. Since there is frequently a division of labor by age, gender or some other criteria (e.g., in some societies inshore gleaning of invertebrates is conducted by females), this information must be obtained from representatives of the appropriate subgroups of the community. These appropriate subgroups can be identified with information gathered as part of the coral reef use indicators specified above. The first step is to ask them to name all the types of fish they know that live on or around the reef. The questioning can be facilitated by asking informants to name organisms at landing sites and markets. A picture book (color pictures are best) can also be used to stimulate acquisition of fish names. After this list is formed, the interviewer can then take each name on the list (e.g., catfish) and ask if there are any other types of 'catfish.' List construction will probably take several days, spending about three hours of the fishers' leisure time on each day.

Ideally, the list should be cross-checked with another group, using the same techniques, but prompting with items from the first group if they are not in the final product of the second group. Similar methods can be used for other reef flora and fauna.

Scientific identification of taxonomic items can prove difficult. These lists are frequently surprisingly long. Pollnac (1980), using this technique in an examination of a coastal, small-scale fishery in Costa Rica, elicited 122 named categories of marine fish captured by local fishers (also see the taxonomies in Chapters 3 and 4). For a coral reef in the Philippines, McManus et al. (1992) list over 500 species of fish associated with a specific reef, suggesting that reef fishers might have more complex taxonomies than the Costa Rican fishers in Pollnac's research. The taxonomic structure of the list (e.g., the hierarchical relationships) will probably provide some clues (see the example in Note 6), but it will probably be necessary to interview some fishers while they are fishing on the reefs and unloading their catches. If someone with a knowledge of reef fauna and flora taxonomy is present, they can attach the scientific nomenclature to the local name. If not, the researcher should take photographs (or collect samples) for later identification of species he or she is unable to identify. Fish identification books, with color photographs, can also be used as a supplementary method to link local and scientific names. Photographs also make an excellent stimulus for eliciting names. Where fish change color and characteristics with age and sex changes, the photographs should include representations of all stages. Some fish also change color when frightened and/or killed, and these factors have to be taken into account.

Depending on resources available, fisher beliefs about and uses for all (or the most important[7]) resources should be elicited. Once again, ethnographic interviewing techniques should be used. A good example of this type of information can be found in Johannes (1981).[8]

Perhaps one of the most significant aspects of this category of information with respect to reef management is the local 'folk science' regarding the reef and its resources. Recently, much emphasis has been placed on the importance of using traditional ecological knowledge in marine resource management (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Johannes 1981). In anthropology, this 'folk science' is referred to as ethnoscience. Ethnoscience and its application to development and change issues has long been of interest to anthropologists (Conklin 1954; Spradley 1969; D'Andrade 1995). Wilson et al. (1994) argue that this knowledge, along with assistance of local fishers in some form of co-management, is the only solution to appropriate management of complex or chaotic fishery ecosystems. Hence, the interest in including this information in ReefBase.

Basically, for each (or each important) resource, investigators should elicit resource harvester knowledge concerning the resource. For example, for a given type of fish the investigator should question the harvester (or a group of harvesters, as discussed above for eliciting taxonomies) concerning numbers, locations, mobility patterns, feeding patterns and reproduction. For each of these information categories, fishers should be queried concerning long-term changes. Reasons for changes should also be determined. Given the species diversity associated with coral reefs, this appears to be a formidable task, but such knowledge will probably only be available for important species (see Note 7). Those are the species the harvesters have been watching, hunting and eviscerating–the ones upon which most of their income depends.

It is important to note that there will probably be intracultural variation with respect to all aspects of traditional knowledge discussed above (Felt 1994; Berlin 1992; Pollnac 1974). Some of the variation will be related to division of labor in the community, as discussed above, but some will be related to degree of expertise, area of residence, fishing experience and other factors. The conceptualization of 'folk knowledge' as 'shared knowledge' implies that care must be taken to not attribute idiosyncratic information as 'folk knowledge.' This is difficult when using the rapid appraisal approach, especially given the anti-survey bias held by some ill-informed advocates of rapid rural appraisal. A survey of, say, 10 to 15 fishers concerning key aspects of 'folk knowledge' can serve to rapidly identify areas of variability which could be addressed in planning future research for management purposes.

Determining use rights can be relatively straightforward unless boundaries are illegally maintained (Pollnac 1984). In the relatively straightforward cases, key informants can provide information concerning: 1) jurisdiction, 2) types (e.g., whether the access is open, communal, or private), 3) what the boundary maintenance system is like (e.g., are boundaries clear and strictly maintained, or are they diffuse, with minor transgressions permissible; see Acheson 1988), 4) whether and how use rights can be transferred, 5) existence of conflicts in use rights and 6) types of surveillance and enforcement, if any.

The description of management efforts is relatively straightforward except for assessment of effectiveness. This assessment should probably include evaluations by resource harvesters, the management entity, local political leaders, and enforcers. Some indicator concerning violations should also be included in the assessment. *ReefBase* will include indicators concerning relative 'health' of the reef. This indicator would be useful as a measure of 'effectiveness' of the management effort, depending on the amount of time the effort has been operating.

PRESENTATION OF INDICATORS IN DATABASE

Format for presentation of RAMP indicators in ReefBase will be developed and modified as the project proceeds (see Chapter 2). It will depend on perceived user needs, and will probably be multilevel (e.g., varying levels of detail will be nested in the database). At a first, most general level, traditional ecological knowledge might be indicated by a value ranging from one to five, with one signifying a very low level of traditional knowledge, and five a complex level.[9]

In all cases the goal will be to enter data at the most precise level of measurement appropriate to the variable under consideration to facilitate statistical analysis. It is understood, however, that availability of information or funds to gather information may result in varying levels of precision. Hence, the database must accommodate different levels of measurement and provide indicators of the methods used to facilitate appropriate interpretation of the data. Levels of measurement are discussed in more detail in the following chapter.

Since information will be derived from different sources, using varying methods, it is important to have fields specifying information sources (references), dates and methods used so that users can decide whether or not the information is of sufficient timeliness, validity, reliability and/or precision for intended analyses. These fields, as appropriate, should be associated with each indicator or set of linked indicators. Details concerning these issues are found in Chapter 2.

NOTES

1. The dependent variables used as examples are just a few among the many that researchers could choose from either the ReefBase or RAMP portions of the database.

2. Where possible and appropriate, national context indicators are made comparable to those used by Cobb and Olsen (1994) in a document directed at developing indicators for evaluation of coastal resource management efforts.

3. Ideally, some sort of scale analysis should be applied to this type of data, but this cannot be accomplished until data from a number of reef local contexts has been collected (see Graves et al. (1969) and Pollnac et al. (1991) for examples). If scale analysis is conducted, ReefBase entries for this variable could be modified at a future date.

4. Commercialization potential is related to Rambo's (1991) observation that the concept 'resource' is socially defined. Applied to the marine environment, a given fish would not be classified as a 'resource' by a social group that had no use for it. It becomes a potential resource, however, when the community learns there is external demand for it. Development of a means for harvesting and marketing the fish converts it into a resource.

5. It is important to note that despite all the emphasis on the relationship between use rights and resource management, some have cautioned that there is evidence that resource destruction can result from privatization. Martinez-Alier (1991) notes that the tragic loss of rain forest in the Amazon is related to privatization of land. He contrasts this 'tragedy of the enclosures' with the 'tragedy of the commons' noting that the enclosures are resulting in loss of access to common lands and proletarianization, as well as ecological tragedy.

6. Sometimes experienced rapid rural appraisal (RRA) advocates tend to over simplify the difficulties involved in obtaining some types of information. For example, the author (Pollnac) has been conducting research in fishing communities for more than two decades. He sent a graduate student researcher to the field in Ecuador with instructions to obtain, among other types of data, names of coastal resources utilized. When the student returned, he asked what kinds of fish were captured. She mentioned pargo amongst others, and when asked what kinds of pargo, she did not know. In Costa Rica,

Pollnac (1980) identified no less than 11 named types of pargo. An experienced fishery anthropologist would suspect that the first name provided would refer to a superordinate category in a taxonomy of fish and inquire, "what kinds of pargo do you catch here?" Basic training in the 'ethnoscientific' method (see Spradley 1969) appears to be essential for RRA practitioners focusing on exploitation of the natural environment.

7. Several techniques can be used to identify 'most important' reef resources. First, when eliciting lists, the initial order in the lists should be recorded for future use. This initial ordering, which will be lost as the lists are expanded and organized hierarchically, provides some indication of the relative salience of items listed. Names appearing early in lists usually signify resources with cultural significance. Types (e.g., genera or species) with a large number of varieties are generally considered culturally significant (see D'Andrade 1995). Finally, relative economic or nutritional importance can be determined by amount harvested, consumed and found in the distribution and marketing system.

It should be noted that the term 'cultural significance' was used above in the discussion of 'important' reef resources. Sometimes a resource may be important to a people for ritual or aesthetic reasons, yet not be nutritionally or economically significant in terms of quantity. Reef resources with cultural significance should also be included in the 'most important' category and evaluated.

8. It is unlikely that users will have detailed information for all named taxa. The detailed information will probably exist for 'important' species (see Note 7). For other species, knowledge will probably be restricted to named groupings (e.g., a higher level in the taxonomy) or specific subsets of species. Hence, obtaining this information may not be as time consuming as one would expect with hundreds of named taxa.

9. An example of this simple type of ordinal ranking is provided in Sorokin (1993) who presents a table where he evaluates on a four-point scale the following nine types of anthropogenic stress in eight reef regions: 1) destructive fisheries employing explosives, heavy trawls, toxic substances; 2) overfishing of fish and other reef fauna, endangering their populations; 3) excavation of sand and lime for construction; 4) tourism; 5) collection of corals and shells; 6) discharge of industrial waste waters; 7) discharge of man-made [household sewage?] waste waters; 8) discharge of fertilizers and pesticides from fields; and 9) pollution connected with construction and

extensive agriculture. While the ordinal ranks provide a neat overview of the stress placed on the reefs in the regions examined, it is not clear how the researcher arrived at the rankings.

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2

GUIDELINES FOR ENTERING HUMAN FACTORS INTO *ReefBase*

Richard Pollnac

INTRODUCTION AND METHODOLOGICAL CONSIDERATIONS

The purpose of this paper is to provide guidelines for entering human factor indicators into *ReefBase*. The indicators included are directed at providing information on coral reef-related human behaviors as well as political, socioeconomic and cultural variables which can be used to assess, predict and potentially manage these behaviors. Justification for the indicators is found in Chapter 1.

LEVELS OF MEASUREMENT

In all cases the goal will be to enter data at the most precise level of measurement appropriate to the variable under consideration to facilitate statistical analyses. It is understood, however, that availability of information or funds to gather information may result in varying levels of precision. Hence, the database must accommodate different levels of measurement and provide indicators of the methods used to facilitate appropriate interpretation of the data.

For example, relative importance of a specific coral reef fish for fisher income could be based on landing statistics and initial selling price (e.g., price paid by buyer to fisher) by species. The landing statistics and value could be analyzed to determine the percentage of income derived from a particular species. This value (percent contribution to fishery income), would be the most precise measure of relative importance of a certain species for fisher income. Alternatively, where landing or marketing statistics are unavailable, the figure could be based on key informant interviews where fishers and/or fish sellers would be asked to list and rank the five most important (in terms of income) types of fish they harvest. Modal ranks for

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each species could be determined and used as a ranking of relative importance. In this case the level of measurement would be ordinal, not as precise as the metric measure. Nonetheless, it can be used in statistical analysis. Sometimes information sources will use concepts such as low, medium, high or some variant of these concepts to indicate a level of importance, use, etc. Despite the fact that these are evaluative concepts, not numbers, they can be converted to numbers signifying an ordinal value. For example, the concepts none, low, medium, high can be converted to the ordinal values 0, 1, 2, 3, respectively.

It is extremely important that the direction (in terms of relative amount) of the ordinal values be known. For example, when ranking tasks are performed (e.g., ranking the relative importance of fish species as in the example above), the most important species is usually given the rank of 'number one' and the least important 'number five,' or whatever the total number ranked ends up to be. In terms of the direction of these numbers as related to the concept 'importance,' the numbers are the inverse (in terms of ordinal quantity reflected by one, two, three, etc.) of the actual ordinal quantity. Correlational analyses using ranks where one is 'most important' can be potentially misleading since if this variable is entered into a correlation analysis with another variable where a higher number equals a higher level of the variable, the sign in the result will be negative when the correlation is in fact positive. Hence, in all cases in this database where the ordinal quantity of the concept being measured is higher than another ordinal quantity, the numeric value assigned will be higher.

Finally, continuing with the relative importance of fish species example, in some cases the source of information may only indicate several species as being important with no ranking. Here we have a simple dichotomy where a given species is either important or unimportant–a simple yes/no, limited choice. This type of information is better than none at all, and it can also be used in statistical analysis; hence, accommodation will be made for it in the database. Therefore, each indicator, as appropriate, will have fields for different levels of measurement.

MISSING DATA

In all cases, fields for which no data is available will remain blank (no entry).

METHODS AND DATA SOURCES FIELDS

Since information will be derived from different sources, using varying

methods, it is important to have fields specifying information sources (references), dates and methods used so that users can decide whether or not the information is of sufficient timeliness, validity, reliability and/or precision for intended analyses. Repetition of this type of information throughout the database would be inefficient. Hence, sources for information can be cited as in a scientific paper (e.g., author's last name and date) which would then be used to refer to the complete citation, entered, along with other citations, in a separate segment of the record. The bibliographic segment of the record would also include information concerning methods, etc. Suggestions for information to be included in the bibliographic segment of the record are included in Appendix I of this chapter.

ORGANIZATION OF GUIDE

The guide is organized into five major categories of indicators: 1) national context; 2) regional context; 3) local context; 4) coral reef use; and 5) coral reef governance. Guidelines for entering data from these categories will be provided in the following five sections.

NATIONAL CONTEXT INDICATORS

National context indicators are relatively straightforward. All, except for fishery, coastal, reef and tourism indicators, are presented, where available, as metric values in country profiles in United Nations or World Bank statistical publications. Some of the summary figures on fishery landings, values and exports are presented as metric data in the United Nations Food and Agricultural Organization's fishery statistics publications.

Other figures need to be obtained from national statistics sources and may be of varying levels of measurement. For example, it may be known that there are fishery exports, but the value is not stated. Publications or information from the department of tourism may note an increase in coastal tourism, but not have figures concerning how much. In these cases accommodation will have to be made for ordinal or nominal data entry. Procedures to be followed for cases such as these will be detailed below.

The following indicators (1 through 12) are available in metric form for most countries. There will be a field for the metric value and associated fields for data source and date of information.

1. *Population*
2. *Population growth rate (%)*

3. *Adult literacy rate by gender*
4. *Per capita GDP (US$)*
5. *Average annual GDP growth rate (%)*
6. *Annual inflation rate (%)*
7. *Balance of trade (US$)*
8. *National unemployment rate (%)*
9. *Total arable land area (sq km)*
10. *Total land area (sq km)*
11. *Length of coastline (km)*
12. *Population density: land, arable land*

The national context indicators listed below may not be available in metric form; hence, there need to be fields which will accommodate an ordinal or nominal evaluation. For example, a report may provide an ordinal evaluation of coastal tourism, stating that it is of low, moderate or high value. These values can be entered into the ordinal value field. For cases where a report states that there is coastal tourism, but not give a value, the nominal field will have a 'yes' entry. A statement that there is no coastal tourism will result in a 'no' entry, and if there is no data the field will be left blank. The same procedure applies to all 'value' indicators below.

13. *Value of coastal tourism (US$; %GDP)*
14. *Value of fishery exports (US$)*
15. *Value of fishery landings (US$)*
16. *Value of reef-related products (US$; %GDP)*
17. *Value of reef-related exports (US$; %GDP)*

The indicators involving trends present additional difficulties. For example, a 10-year trend with respect to fishery production can take a number of forms which would not be adequately represented by subtracting the value for time one from time two and converting the value to percent change. Time one might be slightly lower than time two, but if there had been a relatively large increase in production for five years following time one, followed by a drastic decrease over the last two years, the percent change between the two time periods would misrepresent the actual trend in production. Hence, where metric data is available, the field should contain records for the past 10 years from which the user can calculate the trend. The metric field would thus contain a time series of records.

If metric data is unavailable, available information might allow either ordinal or nominal evaluation. For example, a report may state that there has been a small, moderate, or large increase or decrease in production. This

categorization of the trend can be entered in the ordinal field. Alternatively, the report may only state if there has been an increase or decrease or no change. Categorizations such as these belong in the nominal field. It might be necessary to include a field for a non-metric description of the trend which may be reported. For example, a report may describe a trend such as increasing then decreasing but lower than 10 years ago. Such a field would be a searchable phrase field (e.g., increasing then decreasing rapidly and lower than 10 years ago, etc.).

18. 10-year trend in reef-related products
19. 10-year trend in reef-related exports
20. 10-year trend in coastal tourism
21. 10-year trend in fisher employment
22. 10-year trend in fishery landings

National context data directed at coastal demographic data can also be problematic. In cases where statistics concerning coastal populations are published, the criteria for the categorization must be entered into the database. Where the category 'coastal' is not used, it may be necessary to calculate coastal population from published statistics by summing populations of 'coastal' political divisions for which population data is published. For example, in the Philippines, Fox (1986) calculated number of fishers per kilometer of coastline using figures concerning full-time fishers derived from population census data for coastal municipalities. These figures were cross-checked by visual counts of actual fishers on the water at project locations, and a close correspondence was found. Coastal population density could be calculated using the same approach.

In some cases the political divisions from which population data is available in published reports may be so large as to make the figures unreliable as a measure of coastal population density. Frequently, published data reflects a summation of census tracts. A country's census bureau usually has maps outlining census tracts. Most census bureaus are able to provide these figures or help the researcher identify tracts appropriate for specific questions and recalculate the data for the specific areas identified. There is almost always a fee associated with these special services. A national map outlining the 'coastal' political divisions used in calculating the coastal population figure may help users evaluate the usefulness of the indicator as well as other indicators derived from this figure (e.g., coastal population density). Indicators 23 through 25 will be subject to these restrictions. A field specifying census units used to calculate coastal population must be attached to these indicators.

23. Coastal population
24. Coastal population growth rate (10-year percent change)
25. Coastal unemployment rate (%)

The final national context indicators will be metric and based on availability of data. With respect to number of fishers, there should be a field for total number, full time and part time. A field should be attached to both full and part time specifying the criteria used since this varies across different nations.

26. Total reef area (sq km)
27. Number of fishers
*28. Population density: coastal, reef**

**calculated from data entered*

REGIONAL CONTEXT INDICATORS

Availability, scope and reliability of regional context indicators will vary widely across nations, as well as regions within nations. Sources and methods for these indicators should be clearly specified in fields attached to the indicator field. For example, some data (e.g., amount of land devoted to agriculture, population, etc.) may only be available on a 'county' (or some other local political division) basis, and the watershed is only a part of this division. The attached field should indicate that the statistics apply to a division that includes the watershed which is a specified percentage of the total land area.

The first three indicators are metric:

29. Total size of watersheds (sq km)
30. Population
31. Population density

The following indicators could be metric, ordinal or nominal. It is conceivable that a report might rank the different types of land use and employment from most to least important. These ranks could be converted if necessary (see general methodological considerations) and used in the ordinal field. It is also conceivable that a report might only mention different uses without any figures or ranking. Then the various uses and employment would be entered as either present or absent–a nominal field. Similarly, information concerning unemployment could be metric, ordinal or nominal. Indicators

32f and 33e (industry, percent by type) are table fields which will list industries, by type, and specify the percent of the watershed occupied and employment/ unemployment by each industry type.

32. Land use in watersheds (%)
- *32a. Undeveloped*
- *32b. Residential/built-up*
- *32c. Forest*
- *32d. Mining*
- *32e. Agriculture*
- *32f. Industry (% by type)*

33. Employment/unemployment by major categories (%)
- *33a. Agriculture*
- *33b. Forestry*
- *33c. Mining*
- *33d. Fisheries*
- *33e. Industry (% by type)*

34. Unemployment rate (%)

LOCAL CONTEXT INDICATORS

The local context includes the area of coastal populations directly impacting the reef ecosystem through fishing, mining or tourist/recreational activities. Since technology (e.g., motorization, refrigeration, etc.) influences the distance from which a reef can be effectively exploited, the stretch of coastline will vary from reef to reef and should be described in a memo field attached to the local context indicator. Additionally, one of the units of observation in the local context is the coastal community. The category 'coastal community' refers to the lowest level of political organization characteristic of the nation state with jurisdiction over the reef in question. Since characteristics of this political division may vary from country to country, a memo field should also be used to define 'coastal community.'

35. Definition of local context
36. Definition of coastal community

Some of the local context indicators will be stored by coastal community (e.g., there will be a table with fields for each community) and

some will be stored for the local context as a whole. The following indicators will appear in tables attached to each community:

37. Area of coastal community (ha)
38. Length of coastline (km)
39. Population
40. Number of fishers
41. Settlement pattern
42. Services/facilities
43. Occupations
44. Alternative occupations
45. Unemployment

Indicators 38 through 40 and 45 are metric. Indicators 39, 40 and 45 should include records from the previous census, preferably 10 years prior to current data to enable calculation of trends.

Settlement pattern (indicator 41) is a limited choice field where one of the following categories will be selected to characterize the settlement pattern: dispersed; dispersed coastal and nucleated inland; nucleated coastal and dispersed inland; nucleated coastal and nucleated inland; nucleated coastal; nucleated inland; dispersed coastal; dispersed inland. This is a nominal variable. It might be useful to leave fields for ordinal and metric measures for both inland and coastal, but it is doubtful if data needed to calculate such indices will be available within the lowest level of political organization. To do this, a detailed map with structures (buildings, etc.) would be required.

Services/facilities (indicator 42) is a limited choice checklist composed of the following items which will be checked as either present or absent:

42a. Hospital
42b. Medical clinic
42c. Resident doctor
42d. Resident dentist
42e. Secondary school
42f. Primary school
42g. Public water supply piped to homes
42h. Sewer pipes or canal
42i. Sewage treatment facility
42j. Septic or settling tanks
42k. Electric service
42l. Telephone service
42m. Food market

42n. Drugstore
42o. Hotel or inn
42p. Restaurant
42q. Gas station
42r. Public transportation
42s. Hard-top road access
42t. Banking services

Total number of categories checked will be summed for each coastal community resulting in a facilities/services development index.

42u. Facilities/service development index

Indicator 42t (banking services) does not have to be within the local coastal context as defined above. If there are banking services within the range of normal marketing travel (e.g., a trade center to which people travel once every week or two), banking services will be considered as present. It is a nominal variable.

Indicator 43 will include eight fields providing space for entry of percent distribution of labor force by major occupation category. Although in many cases this will be a metric field, allowance should be made for ordinal and nominal data for each category as discussed with respect to other indicators above. The eight categories are listed below:

43a. Agriculture
43b. Forestry
43c. Mining
43d. Fishery
43e. Industry
43f. Tourism
43g. Other services
43h. Other

Indicator 44 is a checklist of existing alternative occupations appropriate for those who might be displaced by reef management measures. It consists of the same major categories listed for indicator 43. Other local context indicators apply to the entire local context as defined above. Some will be derived from the coastal communities table. For example, indicators 46 through 49 below are derived from a simple summing of the individual community values for indicators 37 through 40, respectively. Indicators 50 and 51 are derived from time-series data for indicators 48 and 49. Indicator

52, the total services facility index, is the mean value of indicator 42u for all coastal communities in the local context. Indicators involving percentages require more complex calculation to derive the summary value for the local context. Percent figures must be converted to numbers for each coastal community, numbers must be summed for all communities in the local context, and percentages recalculated. *Summing percentages and dividing by the total number of communities can result in gross misrepresentation of actual distribution.* This consideration applies to indicators 53 (percent distribution of occupations) and 55 (percent unemployment). If the data (indicators 43 and 45) for deriving these indicators (53 and 55) are ordinal or nominal, the derived indicator should be a simple dichotomy (present or absent) for each category. Users who wish to derive a higher level of measurement (e.g., percent of communities listing agriculture as an existing occupation, percent of communities with high unemployment) can calculate it from the community-level indicator. Indicator 54, alternative employment, is a nominal value for each occupational category (present or absent) derived from indicator 44 at the coastal community level. Users wishing a higher level of measurement (e.g., percent of communities with tourism as alternative employment) can calculate it from the community-level data. These indicators are listed below:

46. *Total area (ha)*
47. *Total coastline (km)*
48. *Total population*
49. *Total number of fishers*
50. *Population growth rate (%/year)*
51. *Fisher population growth rate (%/year)*
52. *Total services/facilities index*
53. *Distribution of occupations (% by categories in indicator 43)*
54. *Alternative occupations (by categories in indicator 44)*
55. *Unemployment (%)*

Some indicators will be entered only at the level of the total local context. Of these, some will be partially derived from previously listed indicators.

56. *Occupational mobility*
57. *Distribution of labor by sex*
58. *Infant mortality rate (per 100,000 births)*
59. *Diversity (homogeneity/heterogeneity)*
    59a. *Economic*

59b. Occupational
59c. Ethnic
59d. Religious
60. Nongovernmental organizations (NGOs)
61. NGO success rate
62. Political organization
63. Population per km of coastline
64. Fishers per km of coastline
65. Population per sq km reef
66. Fishers per sq km of reef
67. Total reef area (sq km)

Occupational mobility (indicator 56) is an ordinal field. The coder will make a judgment concerning the degree to which present users of the reef resources can switch between occupations. For example, if present users practice both fishing and farming, and acquisition of more land is a real possibility, occupational mobility could be classified as high. If no land is available, and there is a lack of other appropriate alternative occupations, occupational mobility can be classified as none. The categories available will be none, low, medium and high.

Distribution of labor by sex (indicator 57) will be entered as a nominal variable for each major occupational category (agriculture, forestry, mining, fishery, industry, tourism, other services and other). The limited choice list will be: 1) all female; 2) mixed, mostly female; 3) equal; 4) mixed, mostly male; and 5) all male.

Infant mortality rate (indicator 58) is a metric field. This data can be calculated from birth/death records for the coastal communities. It is suggested that at least five years of records be used to calculate the rate.

Diversity (indicator 59) will indicate several types of socioeconomic homogeneity/heterogeneity. Economic diversity (indicator 59a) will be indicated with some measure of income distribution. Availability of information on distribution of wealth (indicator 59a) will vary in terms of precision. In some areas, percent of population in various income categories will be available. In others, the data will consist of distribution of land, ownership of productive equipment or material items. Even in cases of highest precision (e.g., percent distribution across income categories) the income categories will most likely differ from reef area to reef area. Hence, this important information should be entered as a memo field from which individual investigators can make decisions concerning the quality of the information and/or recoding strategies.

Indicators 59b through 59d are rough measures of population heterogeneity. Local contexts can be ethnically, religiously, or occupationally homogeneous or heterogeneous. The literature will vary widely in terms of information available to make a determination concerning this variable. Sometimes the source will provide a statement concerning the polarization of the community into groups of one sort or another. In that case, the context for that variable can be coded as not homogeneous. In another, the source might state that most people in the community practice the same religion and manifest the occupational multiplicity common in poor rural areas. In that case, the contexts for religion and occupations can be coded as homogeneous. The lack of comparability and precision in available indicators does not justify more than a nominal measure; hence, the local context will be coded as either homogeneous or heterogeneous for indicators 59b through 59d based on evaluation of the secondary data by the coder.

Indicator 60 will be a metric field. It will consist of the total number of functional, producer-related NGOs (e.g., fisher cooperatives, farmers associations, etc.) in the local context. NGO success rate (indicator 61) is the total number of functioning NGOs divided by the total number of NGOs functioning plus those which failed in the past five years.

Political organization of the local context (indicator 62) is an indicator which delineates the number of levels of political organization at various levels having jurisdiction over the reef area being examined. For example, in some nations the levels of political integration, from the lowest to the highest, are villages within towns, within counties, within states, within the nation. Such a nation would have five levels of political integration, including the nation. The most complex situation imaginable probably will not exceed eight levels; hence, indicator 62 will have eight metric fields, proceeding from the lowest level of integration to the highest. Data will be entered according the following example: Given a local context of 15 villages belonging to five towns in three counties, in two states, in one nation, the first five fields would have the following entries: 15, 5, 3, 2, 1. The last three fields would be blank. Conceivably, there might be more than one nation with jurisdiction over a given reef area. The nations might also be organized into 'common markets' or some such supra-national organization which claims jurisdiction of some sort over common waters. In that case, another level of political integration could be added.

Indicators 63 through 67 are metric. Indicators 63 and 64 are derived from indicators recorded at the community level. Indicator 67 (total reef area) is used along with indicators discussed above to derive indicators 65 and 66.

CORAL REEF USE INDICATORS

Reef use indicators will provide direct indicators of specific impacts on reef organisms. Uses will include harvesting of organisms (including the coral itself) and tourism.

The first field in this section (indicator 68) is a graphic field. It will be a map of the reef area including local reef nomenclature (local terms used to refer to the identified reef and its subunits) along with mapping as perceived by local users. The following fields (indicators 69 through 73) will include the most important flora and fauna harvested or mined by type as well as types of reef tourism and recreation.

68. Map including local reef nomenclature and locations of features as perceived by users

69. Ten most important flora and fauna harvested or mined by type (folk and scientific taxonomies)
For each type:
- Methods (type, when, where)
- Participants (social position)
- Importance (amount/value)
- Post-harvest distribution (e.g., subsistence, market [local, regional, national, export])

70. Contribution to income and subsistence (where applicable) for each major category (e.g., coral reef fish, coral reef invertebrates, etc.)

71. Types of reef tourism/recreation

Indicator 69 will have the following subfields each of which will be a table:

69a. 10 most important coral vertebrates for income
69b. 10 most important coral vertebrates for home consumption
69c. 10 most important non-coral vertebrates for income
69d. 10 most important non-coral vertebrates for home consumption
69e. 10 most important invertebrates for income
69f. 10 most important invertebrates for home consumption
69g. 10 most important reef flora (algae, seaweed) for income
69h. 10 most important reef flora (algae, seaweed) for home consumption
69i. 10 most important corals harvested

One table will be associated with each of 69a through 69i. Each table will have the following fields: 1) methods; 2) season; 3) location; 4) participants; 5) importance; and 6) distribution. Of the six fields, only field five (importance) has the potential of being numeric. If landings statistics (or local market/middleman surveys) and if types can be clearly identified with the target reef) are available, field five will be amount, metric ton (MT) and value (US$). If landings statistics are unavailable, and if it is possible to rank the types in terms of importance, an ordinal rank can be entered with a memo field explaining how the ranking was derived (e.g., modal ranks from a sample of harvesters [identified by type of gear so that evaluations of representativeness of sample can be made since different gears harvest different species] and/or buyers; number of respondents listing the type among the first five out of a sample of harvesters and/or buyers). Finally, in some cases the source of information may only indicate several species as being important with no ranking. Here we have a simple dichotomy where a given species is either important or unimportant–a simple yes/no, limited choice.

Methods will be a field with searchable phrases. It is likely that a given type (e.g., an important coral fish) can be harvested using several different methods (e.g., spear gun, hook and line, poison, dynamite, gill net, etc.), the field should be such that a search would be able to target a specific method (e.g., spear gun) and identify all fish captured with that method, although the fish is also captured using other methods as well (e.g., the field must allow for multiple categories and the ability to search within multiple categories for individual entries).

Season will be an entry reflecting the time of year the type is harvested. The entry will be months identified by number (e.g., 1 = January, etc.).

Location will be a field with searchable phrases (e.g., reef flat, reef slope, reef wall or near reef [adjacent to the reef]). The field must allow for multiple categories and the ability to search within multiple categories for individual entries.

Participants will be searchable phrases which classify the harvesters according to sex and age (e.g., male, female and children). The field must allow for multiple categories and the ability to search within multiple categories for individual entries.

Distribution will be a searchable phrase field including the following categories: home, local market, regional market, national market and export market. The field must allow for multiple categories and the ability to search within multiple categories for individual entries.

Finally, there should be an evaluation of the major categories (e.g., coral versus non-coral fish, etc.) in terms of percent contribution to income and

subsistence (indicator 70). If metric values are available (e.g., harvesting and marketing statistics), this can be calculated from already entered data. If not, informants can be requested to provide an estimate of the relative percentages. If informants find it difficult to estimate percentages, they might be able to rank the relative importance. For example, in a community where coral fish, non-coral reef fish and collecting seaweed contribute to income, they might state that non-coral fish are the most important source of income, followed by coral reef fish, with seaweed collecting contributing little. The entry would then be made in an ordinal field with the respective ranks. As noted above, research methods used by source should be clearly specified in the research methods field so that users can evaluate the representativeness of the sample, etc.

Indicators for reef-related tourism and recreation are listed below:

71. Types of reef-related tourism and/or recreation
72. Potentially destructive tourism and/or recreation-related activities
73. Reef tourism-related support services

Indicator 71 will be composed of the following limited choice fields: a) beach activities (sunbathing, beach combing, swimming); b) reef diving (non-scuba); c) reef scuba diving; d) pleasure boating; e) reef viewing boat tours (e.g., glass-bottomed boats, no diving or walking on reef); and f) recreational fishing. There should also be an 'others' field within which brief searchable phrases reflecting other tourism and recreational activities can be entered.

Indicator 72 will be composed of the following limited choice fields: a) walking on coral; b) anchoring on coral; c) depositing vessel waste in coral areas; and d) collecting coral. There should also be an 'others' field within which brief searchable phrases reflecting other potentially destructive tourism/ recreational activities can be entered.

Indicator 73 will have the following sub-fields, each of which will be a table: a) hotels; b) beach resorts; c) tourist food and/or drink services; d) pleasure-boat tour operators; e) reef-viewing boat tour operators; f) diving expedition tour operators; and g) recreational fishing boat operators. Each of the tables will have fields for the following information: 1) total number; 2) number of male employees; 3) number of female employees; 4) gross annual earnings; and 5) year the type of tourist support services first appeared in the area. The hotel and beach resort tables will have an additional field for total number of beds. Categories c through f will have an additional field indicating number of trips and customers per year.

REEF GOVERNANCE INDICATORS

The governance indicators include knowledge concerning coral reefs, use rights, management efforts (traditional, local and national), as well as the local and national institutional governance settings. Most of the 'raw data' from which these indicators will be developed is complex textual material. Only potentially predictive attributes of this textual material will be abstracted for use in ReefBase.

The first set of indicators related to reef governance is concerned with ecological knowledge of users. Here we are concerned with ecological knowledge of the coral itself as well as associated flora and fauna. This is reflected in indicator 82 and its subcategories.

74. Ecological knowledge of users
  74a. Coral
  74b. Coral-related fauna
  74c. Coral-related flora
75. Perceived resource changes
  75a. Coral
  75b. Coral-related fauna
  75c. Coral-related flora
76. Reasons for changes
  76a. Coral
  76b. Coral-related fauna
  76c. Coral-related flora
77. Variation in ecological knowledge

Each of the subcategories of indicator 74 will have a table associated with it. Each of these tables will have the following set of fields related to taxonomic knowledge: 1) total number of items and 2) number of hierarchical levels. Total number of items simply reflects the total number of entries in a taxonomy; it is a metric number. Number of hierarchic levels reflects the internal complexity of the taxonomy, as well as reflecting a more sophisticated knowledge of the resource wherein the user makes generalizations about similarities and differences of different types. Number of hierarchical levels is determined by counting the number of levels down from the life form level (e.g., fish) to the lowest level in the taxonomy (e.g., hammerhead shark). With this example we would have fish, shark (which is a type of fish) and hammerhead shark (which is a type of shark). If this were the lowest level in the taxonomy, the value assigned would be three.

Each of the tables for the subcategories of indicator 74 will also have fields reflecting knowledge concerning the most important types. Important types are determined in the reef use section. The fields reflecting knowledge are the following: 3) locations; 4) movements (if applicable); 5) seasonal availability; 6) reproduction; 7) diet (if applicable); and 8) total knowledge scale. Since the number of important types will vary from reef to reef, a metric number concerning the number of types for which specific knowledge is present could be misleading. An ordinal evaluation, coding 0 for none, 1 for less than 1/2, 2 for equal to or more than 1/2, and 3 for all is sufficient and would not be misleading. For example, if fishers provided location for all important fish species, the value entered would be 3. If they provided location for one out of five important species (5 being the total number of species deemed important), the value entered would be 1. The total knowledge scale would be a summing of fields 1 through 7, if none of 1 through 7 is coded as missing (e.g., left blank). If any data is missing, the total score cannot be calculated.

Perceived resource changes (indicator 75) refers to long-term trends in each of the three subcategories (indicators 75a through c) as perceived by users. For example, if a fisher is asked to compare his present catches with those of five years ago, he might say they are lower, the same, or better. The coder must be careful to make sure that the perception is attributed to the users, not an observation made by a fisheries officer or research scientist. The entry for this field is a resource users' perception; hence, it would probably be misleading to try to use a metric value. It is best as an ordinal value (e.g., -1 = worse off, 0 = the same, and 1 = better off).

Reasons for change in each of the three subcategories (indicators 76a through 76c) should be limited choice fields, with the following limited choices: 1) too many fishers; 2) overfishing; 3) use of specific gear type; 4) fish have moved away or are hiding from fishers; 5) supernatural (e.g., the gods are angry, it is God's will); 6) others; and 7) do not know. The 'others' field will allow for multiple categories and the ability to search within multiple categories for individual entries. Indicators 75 and 76 can be severely biased by unrepresentative sampling; hence, research methods used by the source must be clearly specified.

At the present time very few researchers have adequately investigated the topic of variation in ecological knowledge with respect to marine organisms (indicator 77). Ruddle (1994) briefly considers influences such as the division of labor by sex as well as continuity and change in technology, but most of the evidence is anecdotal. The topic is discussed in the *RAMP* indicators

chapter (Chapter 1) and the case studies (Chapters 3 and 4), with references to ethnobiological literature where more systematic attempts to understand intracultural variation in ethnobiological knowledge have been undertaken. Given the extremely primitive state of our understanding of variation in traditional knowledge concerning coral reef resources, this field would best be left as a memo field within which variation and methods used to investigate variation are described in paragraph format.

Aspects of jurisdiction, authority and use rights make up the next set of indicators.

78. Jurisdiction
79. Authority
80. Use rights

Jurisdiction refers to the entity (or entities) that have legal control over activities that directly impact the reef and its resources; that is the legally constituted body (or bodies) that can issue laws concerning all aspects of the use of the reef. It is conceivable that different departments and/or levels of administration may have jurisdiction over different aspects of reef use. For example, one may be responsible for living resources legislation, another for navigation practices, another for pollution, seabed mining, etc. The first indicator under jurisdiction is the number of entities that have been given the authority to draft laws impacting reef use.

The second indicator under jurisdiction is the level of political integration delegated the authority to issue laws concerning aspects of the reef within their jurisdiction. For example, in some nations the levels of political integration, from the lowest to the highest, are villages within towns, within counties, within states and within the nation. Such a nation would have five levels of political integration, including the nation. The most complex situation imaginable probably will not exceed eight levels, the highest level being an organization of nations. This indicator will have nine limited choice fields, the first being the lowest level of political integration (e.g., the village) indicated by level one, the second by level two, etc. The ninth field will indicate the total number of levels granted legislative authority.

78a. Number of entities with authority to draft laws impacting reef use
78b. Levels of political integration with authority to draft laws impacting reef use

Legislation can grant authority for control to different entities; hence, the separate indicator for authority. Additionally, authority need not be legal. It can be *de facto*, as in the case of the lobster gangs of Maine, where state law indicates that anyone with a license can set lobster pots, but the lobster gangs actually control where and by whom the pots are set. Therefore there will be two categories of authority:

79a. Formal (legal) authority
79b. Informal (de facto) authority

Both 79a and 79b are limited choice fields with the following choices: 1) secular leaders; 2) religious specialists; 3) fisheries specialists; 4) rights holders; and 5) users associations. There should also be an 'others' field which will allow for multiple categories and the ability to search within multiple categories for individual entries.

Use rights (indicator 80) is a complex indicator with respect to human factors associated with coral reefs. It consists of a complicated nesting of attributes which takes the following form: (rights to what (type of right (who has rights (how are the rights protected (transferability (boundary definition (conflict))))))).

In the 'rights to what' field, we have to consider rights to: a) use the habitat for any purpose; b) to extract specific flora and fauna; c) to use specific extractive techniques (irrespective of target species); and d) use the resource for recreation/pleasure purposes. Use rights will thus be divided into five major subcategories:

80a. Habitat
80b. Species
80c. Gear
80d. Recreation
80e. Other

Indicators 80a through 80d are limited choice fields. Each of these fields will be categorized by a 'type of right' limited choice field which will specify the following types of use right: 1) open access ,which implies no use right restrictions whatsoever; 2) common access, which implies use rights restricted to individuals inhabiting some restricted geographical or political entity (e.g., nation, region, province, town, village); 3) group exclusive, which implies use rights restricted to some specific identifiable groups of individuals (e.g., ethnic, kinship, user organization, etc.); 4) private, which simply implies

that private individuals can hold rights; and 5) other. The 'other' category will be a searchable phrase field that allows for multiple categories and the ability to search within multiple categories for individual entries. This will permit entry of less common or unexpected user right categories.

The common and group exclusive limited choices will each have 'who has rights' limited choice and searchable phrase fields attached. The limited choice and searchable phrase fields will permit specification of the geographical or political entity for the common category and type of exclusive group. The limited choice field for common access will have the following choices: a) nation; b) region; c) province; d) town; e) village; and f) other. The 'other' field will be a searchable phrase field that allows for multiple categories and the ability to search within multiple categories for individual entries. This will permit entry of less common or unexpected common use right categories. The limited choice field for group exclusive will include the following choices: a) ethnic; b) kinship; c) user organization; and d) other. The 'other' field will be a searchable phrase field that allows for multiple categories and the ability to search within multiple categories for individual entries. This will permit entry of less common or unexpected common categories of groups with use rights.

Common, group exclusive and private use rights imply the ability to exclude outsiders from the resource. This usually requires some type of surveillance and enforcement. Hence, each of these categories will be sub-categorized according to types of surveillance and enforcement–the 'how are the rights protected' field. Surveillance will be composed of two limited choice fields, WHO, specifying who conducts the surveillance and HOW, specifying the means by which the surveillance is conducted. WHO will have the following limited choices: a) none; b) official (e.g., marine police, environmental management officers, etc.); c) user groups; d) supernatural; and e) other. HOW will have the following limited choices: a) none; b) deploy patrol boats; c) post guards at perimeter; d) deploy supernatural entities; and e) other. The enforcement indicator will specify punishment for violators. The limited choices will be a) none; b) fines; c) jail terms; d) social or physical banishment; e) corporal; f) capital; g) supernatural; and h) other.

The group exclusive and private categories (with group exclusive this applies to the categories of group exclusive) will also be sub-categorized according to transferability of use rights. This 'transferability' limited choice field will include a) non-transferable; b) inheritable; c) permitted to sell or trade; and d) obtained by joining group (e.g., marry into, join organization, etc.). The final category (d) only applies to the group exclusive category.

The common, group exclusive and private categories will have a boundary definition field attached to their subcategories. The boundary

definition field will provide an evaluation of the strictness of the definition of the boundary within which the use rights are held. For example, a boundary defined as "500 meters from the low tide line of X Island," would be a strictly defined boundary. A boundary defined as "the waters in which the fishers of X have traditionally fished" with no further definition would be a diffuse boundary. Similarly, a statement such as "around the Y reef" would be classified as diffuse without further specification. In some cases there will be no boundary; e.g., the fishers may be given the right to fish a certain species no matter where it occurs. Given these considerations, the boundary definition field will be a limited choice field with the following limited choice categories: a) strictly defined, b) diffuse and c) none.

The final sub-categorization for all types of use rights involves the presence or absence of conflict. This will be a limited choice field with the choices conflict or no conflict.

The use rights indicator, as presented thus far, is composed of a complicated nesting of categories. Basically, a system is needed which can result in output which would reflect a nesting as complicated as:

I. (species(group excl.(supernatural sur. and enf.(kinship(diffuse bound. (trans. (inher. (conflict))))))));
***and** (species(group excl.(user org.(org. sur.(official enf.(strict b.(non-trans.(no conflict))))))));*
and** (species(private(priv. surv. and enf.(trans.(trade or sell(conflict))))), etc. **for the same reef.

It is also essential that the user be able to convert a specific nesting (or set of nestings) to a variable. For example, one should be able to request the database to find all instances of:

II. (a(b(c(d(e(f))))) and/or (ai(bi(ci(di(ei(xi))))))

...and give the reefs with these combinations a score of 1 for variable Z, all other cases receive a score of 0, cases with missing data receive BLANK. If this is not possible, perhaps some database expert can devise a better method for entering these variables.

The management efforts indicator will also require the type of complicated nesting described for the use right indicator. The nesting required will take the following form:

III. (what(how(formality(who(user(surveillance(enforcement(cost (impact))))))))

Each of the nestings represents a limited choice field with an 'others' category of searchable phrases.

The 'what' indicator (indicator 81) identifies the category of phenomena managed and is composed of the following limited choice fields plus an 'others' category of searchable phrases:

81a. None
81b. Land-source pollution
81c. Marine-source pollution
81d. Floral resource extracted
81e. Faunal resource extracted
81f. Directly destructive activities
81g. Other

Indicators 81a through 81e are self explanatory. Field 81f will be selected if the activity managed is one that directly damages the coral (e.g., blast fishing, use of poisons for extracting fish from corals, destruction of coral by anchoring, walking on, banging on to scare fish, etc.). Each of fields 81b through 81g will have a searchable phrase field attached to identify the type being managed at a more specific level.

The 'how' indicator (82) identifies the technique of management used and is composed of the following limited choice fields plus an 'others' category of searchable phrases:

82a. Sanctuary area
82b. Gear restrictions
82c. Species quota
82d. Species closure (zero quota)
82e. Activities restrictions
82f. Remedial practices
82g. Restoration
82h. Others

Indicators 82a through 82d are, for the most part, self explanatory. Indicators 82b through 82e can be year-round or seasonal. Indicator 82e refers to restrictions on specific activities such as those classified as directly destructive activities (81f) or activities producing the pollution identified in indicators 81b and 81c. Remedial practices (82f) refers to management required practices directed at reducing the anthropogenic impact on the coral. For example, requirements for 1) adequately maintained septic systems to

reduce pollution from human wastes; 2) cooling of power plant effluents; 3) reducing or eliminating the use of specific pesticides in the watershed; 4) etc. Restoration (82g) refers to direct restoration of the resource by culturing practices (e.g., replanting, seeding, releasing cultured organisms, etc.). Indicators 82f and 82g will have associated limited phrase fields for more specific information (e.g., for 82f the limited phrase might be septic system maintenance).

The formality indicator (83) identifies whether or not the management effort has been formalized in terms of being officially published legislation versus an informal effort. This indicator is a yes/no limited choice for formal.

The 'who' indicator (84) identifies the entity ultimately responsible for implementing the management effort and is composed of the following limited choice fields plus an 'others' category of searchable phrases:

84a. Supra-national organization
84b. National government
84c. Regional government
84d. Local government
84e. Non-local nongovernment
84f. Local nongovernment
84g. Others

Indicators 84a through 84d are self explanatory. Indicator 84e (non-local, nongovernment) refers to regional or possibly national NGOs such as a formally recognized group of environmentally concerned citizens who have the objective of preserving a specific resource, or an industry group (e.g., a regional or national fishers' cooperative federation) concerned with the resource. Local nongovernment has the same interpretation, but the group must be constituted at the local level as defined above. Indicators 84e and 84f will have searchable phrase fields attached to more specifically identify the type of group (e.g., environmentalist, user cooperatives, etc.).

The 'user' indicator (85) indicates the degree of user (e.g., fisher, tour operator, etc.) involvement[1] in the management effort as designated by the following categories:

85a. None
85b. Consultative management
85c. Co-management
85d. Community management

Although many have treated the concept 'co-management' as a dichotomy, it clearly represents a continuum, ranging from very little, or token local involvement (e.g., 'consulting' with the fishers[2]) to extensive local involvement, with little input from a higher level of political integration. The state of the literature regarding co-management is not at the stage where one would feel confident creating dichotomous or ordinal categories which would have cross-cultural reliability or validity; hence, indicators 85b, 85c and 85d will be memo fields which will include brief descriptions of the system in place.[3] Users can decide whether to interpret the memo field as a dichotomy (e.g., present/absent) or convert the memo field to some sort of ordinal rank.

The surveillance category indicates by whom, and how, surveillance of compliance with management efforts is conducted. Surveillance will be composed of two limited choice fields, 86 specifying who conducts the surveillance and 87 specifying the means by which the surveillance is conducted.

86a. None
86b. Official (e.g., marine police, environmental management officers, etc.)
86c. User groups
86d. Supernatural
86e. Other
87a. Patrol boats
87b. Shoreside monitoring
87c. Deploy supernatural entities
87d. Other

The enforcement indicator (88) specifies punishment for violators as designated by the following limited choice categories.

88a. Fines
88b. Jail terms
88c. Social or physical banishment
88d. Corporal
88e. Capital
88f. Supernatural
88g. Other

Indicators 86 through 88 are self explanatory.

The cost indicator (89) is a metric field where the total administrative

cost of the management effort is to be entered. In most cases, this will not be available. Methods for determining these costs are forthcoming. The final indicators concerning management efforts address the effectiveness of the effort. The first four major categories address perceptions by different categories of individuals, the fifth addresses violations.

90. *User perceptions of effectiveness*
91. *Management entity perception of effectiveness*
92. *Local political leader perception of effectiveness*
93. *Enforcer perception of effectiveness*
94. *Violations*
95. *Date*

Indicators 90 through 93 will have both ordinal and nominal fields associated with them. Since many different methods can be used to make these assessments, it is important to specify methodology in the methods' field. For example, one source may have fishers rank the effectiveness of a management effort on a scale of from 1 to 10; another may use a scale of from 1 to 5, another may simply have three categories: effective, somewhat effective, and not at all effective, which can be converted to a three-point ordinal scale. Users who want a maximum sized sample with scale comparability could specify criteria to change all scale types to a three-point ordinal scale. Users who want the finest discriminations on this scale could select only cases with the maximum number of ordinal levels. The nominal field would be used if there is only a statement as to whether the effort is effective or not.

The violations indicator (94) will have three fields associated with it: metric, ordinal and nominal. If enforcers keep records of numbers of violations and dates, a rate concerning number of violations per month will be entered in the metric field. Sometimes only information at the level of evaluations like many, few or no violations will be available. This would convert to a three-point ordinal scale (2, 1, 0, respectively) to be entered in the ordinal field. Finally, it might be a simple violations versus no violations, which would be nominal.

The date indicator (95) will be composed of two fields. The first field will be devoted to the year of effort implementation. This information will be relatively easy to obtain with regard to formal efforts since the legislation will be dated and recorded. A second field will be used for informal efforts (e.g., 'traditional' management or locally developed practices), when an exact date cannot be determined. The field will be a searchable phrase field wherein entries such as 'recent,' 'five or 10 years ago,' 'in the distant past,' etc. will be recorded.

The resource evaluation portion of *ReefBase* will include indicators concerning relative 'health' of the reef. These indicators will be useful as a measure of 'effectiveness' of the management effort, depending on the amount of time the effort has been operating and the dates for which the assessments are available. If possible, it would be ideal if pre- and post-management effort assessments are available, then a dependent variable concerning impacts could be constructed.

NOTES

1. The use of the concept 'user' as the name of the field, and the concept 'community' in the indicator category reflects an ambiguity in the literature. When we speak of 'community' management or 'co-management' of fisheries, do we mean the community of fishers or the entire community including farmers, and every other category? For purposes of this database, the searchable phrase fields attached to indicators 84e and 84f will serve to specify those ultimately responsible for implementation (as described in the text), and searchable phrase fields attached to indicators 85b and 85c will indicate the degree of involvement of users as well as other local community members.

2. Most researchers dealing with this issue make the distinction between consultative management and cooperative co-management (e.g., McGoodwin 1990). Consultative management would involve establishment of government entities which would consult with fishers' organizations before and during the preparation of management plans. The content, style and frequency of consultation will, of course, vary from system to system.

3. Co-management is succinctly defined by Pinkerton (1992:331) as "...power-sharing in the exercise of resource management between a government agency and a community or organization of stakeholders." The realization of this concept also includes several variables such as content, structure and, most importantly, degree of power sharing. For example, a precise description of any system of co-management must evaluate the degree of rights and responsibilities of both the government and the fisher organization with respect to information generation, rule making, surveillance and enforcement (cf. Pollnac 1994). In a recent publication, Pinkerton (1994:322-326) has discussed degrees of power sharing ('accommodations') between local and state entities, using a 10-point scale, but no specific criteria are cited for evaluating where along the 10-point scale a specific system should be located.

APPENDIX I TO CHAPTER 2

EVALUATION OF SOURCES OF INFORMATION

INTRODUCTION

It is extremely important to have some means of evaluating the quality of the information in a database such as *ReefBase* with *RAMP*. Careful researchers using the database to test hypotheses or plan future research should be concerned with the reliability and validity of the information. Since much of the data will be abstracted from written documents, and since some users may not have access to these documents, it is essential that some indication of the quality of the information be attached to information in the database. Since all sources of information will be cited, the evaluation can be attached to the citation field as an evaluation field.

Some readers may question the necessity of evaluating published information, assuming that if someone went through the expense of publishing a document, it must be accurate. There is, however, a great deal of evidence indicating that questionable, if not outright erroneous findings are published in refereed journals and books, as well as the 'gray literature' that serves as an outlet for much applied research (Katzer et al. 1982). At this point, it is important to note that much of the information concerning coastal zones in developing countries is published in 'gray literature.' Over 30 years ago, Naroll (1962), in a book on data quality control for quantitative cross-cultural research, argued that the comparativist has a duty to evaluate report reliability. Additionally, the author has had experience with reading published materials (in some cases, in refereed journals) concerning fisheries in a developing country context, then conducting research in the same areas (in one case, just a few months later) and being unable to find the same, or even remotely the same phenomena which were essential to central arguments described in the published papers.[A1] These experiences have engendered a degree of skepticism which can only be reduced by better methods and specification of methods in published reports. Specification of methods is expected in a scientific report.

The author's own experience in collecting data in coastal communities has led to further concern with the accuracy of published information.[A2] For example, one would think that a datum as simple as the number of fishing boats associated with a specific community would be relatively straightforward and simple to obtain. The author has been pursuing this simple number in fishing communities around the world for the past 20 years, and his recent, not unique experience for a case study associated with this book (Chapter 3) should serve as an illustration of the need for specification of method. Numbers of fishing vessels supposedly fishing from different villages in the study area varied significantly from one datum source to another. For one village the number of boats reported by different sources varied between seven and 160. Detailed discussion of these differences and the criteria used to determine a reliable data source is rather lengthy; hence, it is reported in Note A3 to the appendix. The discussion, however, should cause one to pause and ask, "How did the researcher obtain that information?" when reading that there are X number of fishing vessels in a given area. Actually, one should pose that question concerning every datum; that is why it is important to evaluate the methods in a report prior to using its findings.

REPORT EVALUATION FIELDS

There are a number of dimensions along which a report can be evaluated. For purposes of this database, the focus will be on aspects that can be used by the user to evaluate the information in terms of reliability for the user's needs. Methods of report evaluation will be as objective as possible. They will be superficial in the sense that they will not be directed at making evaluative statements about operational definitions and specific sampling, measurement and analytic techniques.

GENERAL DESCRIPTION OF METHODS

One field will be devoted to an ordinal value associated with descriptions of methods in the report. Scientific papers and monographs traditionally have a section devoted to a description of methods used. Frequently it is a methods section, chapter or appendix. Sometimes, methods are detailed in a relatively long footnote. Although lack of such a section does not necessarily mean that the researcher uses inadequate methods or is unconcerned about method, the user has no way of knowing; hence, questions concerning the reliability of

the information can become more salient for the user. The following codes[A4] will be used to describe the general description of methods:

3. *A section of the report (e.g., chapter, section, footnotes or appendix) deals specifically with methods employed to obtain information.*

2. *There is no special section dealing with methods, but methods are the subject of comments for some information.*

1. *There is minimal attention paid to methods. There is only occasional information concerning the source of information.*

0. *There is no mention of methods.*

SAMPLING STRATEGY AND SAMPLE

The concept 'sampling' will be used in its broadest sense for this indicator. Users need to know about the source of information. If percentages or a statement such as 'most' are used in the report, it is important to know if they are based on only a few or many interviews. For example, a statement like "67 percent (or most) of the fishers are against the use of dynamite" is significantly different if it is based on three interviews in contrast to 30 interviews. Further, the user has the right to know how the interviewees were selected. The statement above would mean one thing if it were obtained from underwater spear fishers, who do not use dynamite and could be harmed by others using it, and something else if obtained from a representative sample of all fishers. Granted, these are extreme examples, but the user does not have to stretch his or her imagination to see that information can be quite biased by lack of concern with selection of information sources.[A5] The following codes will be used to describe sampling strategies and samples:

2. *Sampling strategies and sample sizes are clearly described. The researcher reports how many and what types of individuals were interviewed. Where descriptive statistics (e.g., percent, measures of central tendency, etc.) are used, the researcher reports both sample size and specific sampling strategy (e.g., random, stratified random, cluster, systematic, opportunistic, etc.) along with the rationale for the strategy selected.*

1. *Only cursory descriptions of sampling strategies are included. For example, the researcher might report that "five fishers were*

interviewed," but say nothing about their representativeness or other characteristics.

0. No discussion of sampling strategy or sample sizes.

USE OF DESCRIPTIVE STATISTICS

This indicator simply indicates the presence or absence of descriptive statistics in the report. The presence or absence of descriptive statistics should in no way reflect on the usefulness of the report for some types of information. Codes for this indicator are as follows:

1. Descriptive statistics (e.g., tables with counts of items or people, percents, means, modes, medians, etc.) used in the report.

0. No descriptive statistics used.

MEASURES OF CENTRAL TENDENCY AND VARIATION

This indicator tells that the report goes a bit beyond providing numbers like counts, percent and measures of central tendency. It indicates that the researcher is aware of the importance of ranges of variability in the numbers by providing standard deviations for means and confidence intervals for percentages. Codes for the indicator are as follows:

1. Confidence intervals and/or standard deviations are presented, as appropriate, with reported statistics.

0. No measures of variation are used.

METHODS FOR DERIVING ORDINAL EVALUATIONS

The indicator tells whether the researcher describes the method used to develop statements involving ordinal quantifiers such as 'most,' 'few,' 'about half,' etc. Many social science reports are characterized by such ordinal quantifiers. Since they imply some type of evaluation, it is important to know if they are based on statements made by one key informant, interviews with more than one (how many) individual, rough observations of quantity (e.g., when driving through a village, one notes that only a few of the many houses have glass windows), etc. Codes for the indicator are as follows:

1. Methods for deriving ordinal evaluations are described.

0. No description of methods for deriving ordinal evaluations.

VARIABILITY IN INFORMATION

Statistical measures of variability were discussed above. Obviously such measures cannot be applied to more 'qualitative' information obtained from in-depth interviews. Nevertheless, there is no question that most, if not all, information is characterized by some type of variability. Different people give different answers to the same question (see appendix Note A5), attributes (physical, economic, social, cultural, psychological, etc.) vary across individuals, etc. Users should question reports that boldly make statements such as "the fishers of village X do Y." They should be even more skeptical concerning statements such as "the fishers of village X believe Z." Nevertheless, we frequently see such statements in the literature. Codes for this indicator are as follows:

1. The researcher discusses the fact that different people provide different responses to questions; that there are some differences in the attitudes, beliefs and values of people; that some informants give better information than others, etc.

0. There is no discussion of variability. People are treated as a homogeneous whole, manifesting the same attitudes, beliefs and values.

SENSITIVITY TO POTENTIAL FOR BIAS

Bias can be extremely difficult or impossible to detect, especially in qualitative studies with little or no discussion of methodology. For example, a theoretical bias of the investigator (e.g., the assumption that all traditional fishers have a conservation ethic, we just have to find it) could have resulted in accepting the first answer to the question concerning the demise of beach seining (see Note 19, Chapter 4), with no further probing. How would we know that there was or was not bias, unless the researcher reports that further probing elicited no additional reasons? Researchers can also communicate their biases to the individual being interviewed. They can pose a question with an imbedded response; e.g., "the fishers do X because of Y, don't they?" (once again, see Note 19, Chapter 4 for an example of this type of question).

Interviewee's responses can also be biased by past experiences or by their expectations of what is socially acceptable, or what the researcher wants to hear. For example, if past experience has led the interviewee to expect that investigators who ask about fish are interested in conservation, they will probably provide a conservation-oriented response (also see Note 19, Chapter 4 for an example of this type of response).

The structure of an interview could also result in biased responses. For example, if a series of questions concerning attitudes toward various conservation practices are followed by questions involving reasons why local fishers do or do not use certain types of gear, the responses may be biased in terms of conservation-oriented responses that may not have been provided if the gear use questions were first.

Since bias is an important, ubiquitous problem, many researchers present their methods so that the reader can determine the potential for bias. Where there is no specific methods section, an awareness of the possibility for and concern for dealing with bias should be voiced, especially with regard to behavior that has some social valuation. Codes for this indicator are listed below:

1. *The report either provides a sufficiently detailed description of methodology so that the user can evaluate the potential for bias, or the investigator provides a specific discussion that indicates an awareness of the possibility for bias and a concern for dealing with bias.*

0. *There is neither a detailed description of methods nor a demonstration of concern for bias.*

TIME SPENT AT FIELD LOCATION

While the topic of investigation usually dictates how much time should be spent at the field site, the time pressures associated with applied work can result in "in and out the same day in an air conditioned vehicle" assessments. This does not mean that three years in a village will guarantee accurate information, but the longer the time, the more likely the locals will trust you enough to give honest responses, the more likely the various potential for bias will be uncovered, and the more likely you will be able to observe the behavior you are investigating.[A6] The indicator will be a simple notation of the number of weeks spent at the research site.

- *Number of weeks spent at research site. If less than one week, the number recorded will be zero.*

- *Blank. No information provided.*

EXPERIENCE IN COASTAL COMMUNITIES

The difficulties involved with collecting information in coastal communities, as discussed in Note A1, suggest that researcher's experience may be a useful indicator. Some people never learn anything, and some make extensive preparations and sensitize themselves to potential problems through reading the literature, so this will not be a perfect indicator.

2. *Cited publications written by the researcher or other evidence indicate more than five years of experience in coastal areas.*

1. *Cited publications written by the researcher or other evidence indicate less than five years but more than one year of experience in coastal areas.*

0. *Evidence indicates this is the first experience in coastal areas, and/or the experience was less than one year.*

LITERATURE REVIEW

Most good research is based on or builds on previous research. Concepts are defined in terms of previous use of the concepts, previous research on the same topic or geographical area is reviewed and evaluated, and the relationship of the present report with existing literature is detailed. This is usually referred to as good scholarship, and it is unfortunately minimized in much applied work. Sometimes the employer for the applied investigation discourages scientific citation as a waste of paper; hence, lack of references may not always be attributed to a weakness on the part of the investigator. Nevertheless, a good literature review is frequently associated with a careful investigator who wishes to apply as much learning as possible to the topic being investigated. Hence, the number of references cited stands a good chance of being related to the quality of the report. This indicator will be a simple count of the number of references cited in the report.

- *Number of references cited.*

SUMMARY EVALUATION

It might be possible to derive a summary evaluation from the values associated with the different indicators. This should not be a strict summing of the numbers associated with each indicator, because the literature review indicator and time spent at field location could contribute too much to the summary figure. If it is felt desirable to have a summary figure, the number of references cited could be divided by some constant (say 10) to reduce its contribution to the total score. A more valid approach for determining the constant would be to take a sample of reports (say 100-150), calculate the mean number of references and use this figure as the constant. With regard to the time at field location indicator, it depends so much on the size of the site and the topic of the research that it is hard to not feel that any figure selected would be arbitrary. We could either eliminate the time at site indicator from the summary figure, or tentatively select 'zero' for less than one week, and 'one' for anything over a week until further evidence suggests a better approach. Some sort of scale analysis of this summary measure, as well as its correlation with evaluation of the reports by 'expert' readers, would form a good research project for the future.

NOTES TO THE APPENDIX

A1. It is unlikely that researchers were falsifying data. The differences probably result from inadequate methods (e.g., posing questions in such a manner that the response would be biased, inadequate observation, inadequate cross-checking of information, etc.).

A2. A number of the characteristics of the coastal zone, especially characteristics associated with fishing communities, complicate data collection procedures (Pollnac 1988a; Pollnac and Pereira 1995). First is the high degree of biodiversity which is exploited, the coastal zone having a combination of both land and sea organisms as well as organisms unique to the interface between the two. In the case of coral reef areas, the biodiversity is even greater.

In combination with the large number of species hunted and gathered in the coastal zone, one has to take into account the fact that while some resources can be harvested year-round, others are seasonal; hence, observation of activities and salience of activity in terms of responses to queries will vary depending on time of year. In some cases seasonality is the result of migratory species, and in some regions segments of fishing communities migrate along the coast following the fish, further complicating data collection techniques. For example, parameters as basic as population, household size and structure, and sex ratios can vary greatly from season to season (Pollnac 1988b).

Feeding habits of aquatic fauna also influence harvest time. If a fish feeds at night, it is harvested at night when many field workers would probably want to be sleeping. Fish are also harvested at night and landed in the very early morning to take advantage of cooler temperatures for distribution of a highly perishable product.

Concomitant with the species diversity of the coastal zone is a great diversity in extractive technologies. There are many gears that an inexperienced person might not even recognize such as fish weirs, basket traps, harpoon-like capturing devices, etc. Data collection techniques relying on observation as a part of the data gathering process need to be informed concerning this technological diversity.

A further condition influencing data collection techniques is the fact that most aquatic organisms are underwater and invisible. Finally, although the diverse organisms are located in a relatively small area, observation of human hunting and gathering activities is inhibited by the relative inaccessibility of the open ocean, lagoons, swamps and estuarine waters where

organisms are harvested. This is further complicated by the fact that when boats are used, landings can be made at several points along the coast or fish captured may be transferred to a carrier ship at sea, complicating observational assessment of landings at any one point.

The above considerations clearly indicate that there are special difficulties involved in obtaining information from fishing communities. Individuals unaware of these environmentally related difficulties may make unintentional errors in data collection; hence, users of information concerning the sea and coastal zone must be sensitive to the possibility for these types of errors.

A3. While collecting information concerning the number of fishing vessels in villages (barangays) in the study area, it was apparent that there were sometimes exceptional differences between the figures from a survey conducted in late 1994 by the Office of the Municipal Agriculture Officer, figures from a 1993 report prepared by a consultant, those provided by barangay officials (February 1995 interviews), and those provided by the individual responsible for registration and painting of the vessels (February 1995 interviews). An extreme example from one village should serve to illustrate the differences uncovered and the problems involved determining this one 'relatively straightforward, simple datum.'

Differences between various supposedly 'knowledgeable sources' with respect to one village were so great that it provides a prime example of the need to cross-check information. The figures speak for themselves: figures published by a consultant in 1993–three motorized, four non-motorized boats (many more than this were anchored at the main landing site when we visited the community); Office of Municipal Agriculture Officer 1994 survey–49 boats; ex-barangay captain of the village who is an active fisher and lives among the fishers–50 unmotorized, 3 motorized boats; barangay secretary–150 non-motorized and 10 motorized boats; individual responsible for vessel registration and painting–84 non-motorized and one motorized. The barangay secretary presented questionable information on household occupations and simply subtracted the number of farming households from the total number and assigned the remainder to fishers. His boat numbers were probably influenced by that number and are grossly out of line with other figures (and observations). Information on how these differences were resolved are detailed in Note Two, Chapter Three.

A4. The codes are purposely ordered so that a higher number is attached to a higher level of concern with methods. Hence, the user can simply use them as codes for the description attached to the code or as an evaluative

statement concerning the report. This holds true for all of the data quality control indicators used here.

A5. Representativeness, especially when dealing with very small numbers of in-depth interviews, is a very important consideration. The experiences and knowledge of different individuals can have an important influence on their responses. We all know this (one believes), but there appears to be an apparent disregard for this important aspect of selecting interviewees on the part of investigators in the field situation. The author has observed it as well as discovered it through interviews with other investigators.

Obtaining information concerning fishers is difficult in most situations (see Note A1, above) but more so in a situation where the investigator's knowledge about the situation is inhibited by cultural and linguistic differences. In such a situation it is easy to gravitate to the individuals who appear to want to talk to you, to those suggested by local government representatives or fishery researchers, to those residing by the road, to those least likely to reject you. But, those most accessible are frequently those least representative or (and most important) those with most experience in telling the story they think you want to hear. A brief, recent example illustrating this problem is detailed in Note 19, Chapter Four.

A6. Most field researchers have stories to tell concerning 'facts' they learned the first few days or weeks in the field which were later found to be inaccurate. If I only had a few days to spend at the bay in northern Jamaica, I may have not had the time to probe for further information and question additional fishers to correct the responses as reported in Note 19, Chapter Four. Also a recent experience: if I spent only a few days in the municipal center questioning officials and fisher representatives, I would have believed reports that fishers did not fish in a declared sanctuary around Atulayan Island in the Philippines. Moving to and living on the island which was the center of the sanctuary, gaining the trust of and interviewing common fishers, and observing constant violations of the sanctuary led to a more accurate report (see Chapter 3).

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3

ASPECTS OF THE HUMAN ECOLOGY OF THE CORAL REEFS OF ATULAYAN BAY

Richard B. Pollnac and Maharlina Luz G. Gorospe

INTRODUCTION

The purpose of this chapter is twofold: first, to examine selected aspects of the human context of the coral reefs of Atulayan Bay, Camarines Sur, the Philippines; second, to provide detailed comments on the strengths and weakness of the methods used to obtain the information as a step in developing a standardized methodology for conducting similar research elsewhere. It represents the first field test of the present attempt to develop a set of management-related indicators for a worldwide database on coral reefs.

It has become increasingly apparent that attempts to understand the ecology of coral reefs must account for the behavior of humans. Humans are one of the major predators of reef fishes in many parts of the world. Humans also cause direct damage to coral by using destructive fishing techniques, improper vessel anchoring and recreational activities, and coral mining for building materials and ornamental uses. Indirect damage is caused by land-based human activities such as deforestation, mining, agriculture and aquaculture, electric power and desalinization plant operation, and waste disposal (both human and industrial) which result in various types of pollution (e.g., nutrient enrichment, sedimentation, poisoning, etc.) having negative impacts on reefs and associated organisms (Sorokin 1993). Awareness of these assumptions has resulted, in some cases, in attempts to mitigate these negative impacts through some form of management (e.g., White et al. 1994, Pomeroy 1994, McGoodwin 1990). These coral reef-related human behaviors and their management are intimately related to political, socioeconomic and cultural aspects of the populations dependent on, responsible for or somehow impacting the coral reefs under consideration. This chapter examines aspects of the human context impacting the coral reefs of Atulayan Bay.

The importance of developing a standardized methodology for investigating human factors associated with coral reefs cannot be overemphasized; hence, the chapter also comments on methods used. At present the coastal zone and fisheries management literature is characterized by case studies conducted by many different individuals, with unknown biases, and varying research methodologies and disciplinary perspectives. Numerous attempts have been made to summarize such case studies, fitting them into general theoretical frameworks from the social sciences (e.g., Pomeroy 1994; White et al. 1994; Ostrom 1990; McGoodwin 1990; Pinkerton 1989a). Nevertheless, decisionmakers are still faced with a bewildering array of allegedly crucial factors, with no way of evaluating their relative importance or interrelationships (Pollnac 1994). It is clear, that systematic, quantitative research is needed to provide a solution to this problem.

The problem with existing case studies is that they are not strictly comparable. There are two major faults with existing information. First is lack of correspondence in terms of the categories of information examined in the reports. For example, one may emphasize variable X as an important factor in successful management, while some others make no mention of variable X; we have no way of knowing whether variable X is actually absent for the case or simply not researched or commented upon. Second, when information on selected categories is present in a sample of case studies, it is obtained with the use of different research methodologies (e.g., differing operational definitions and sampling procedures). This results in data on the same variable which are not strictly comparable (e.g., level of measurement or attributes of the variable). This makes it impossible to do complex multivariate analysis without eliminating some cases and/or reducing the precision of the variable (e.g., converting interval to ordinal measures because some cases only measured at the ordinal level, and too many cases would be lost if they were eliminated). This chapter will discuss these issues for categories of information examined.

Since this is the initial field testing of an attempt to develop a set of standardized indicators concerning human factors associated with the management of coral reefs (see Chapters 1 and 2), the quality of information for some categories suffers as a result of the time devoted to others. The lessons learned will be applied in the next field test to further develop specifics of the methods to be used.

ATULAYAN BAY

MARINE-ORIENTED CONTEXT

Atulayan Bay is located in Lagonoy Gulf, the largest fishing ground in the Bicol Region of the Philippines (see Figure 1). Lagonoy Gulf has an area of about 3000 km^2, about 91 percent of which is deeper than 10 fathoms (Garces et al. 1995). Some 42 percent of the more than 20,000 households in the coastal barangays (villages) of the gulf rely on fishing for their livelihood

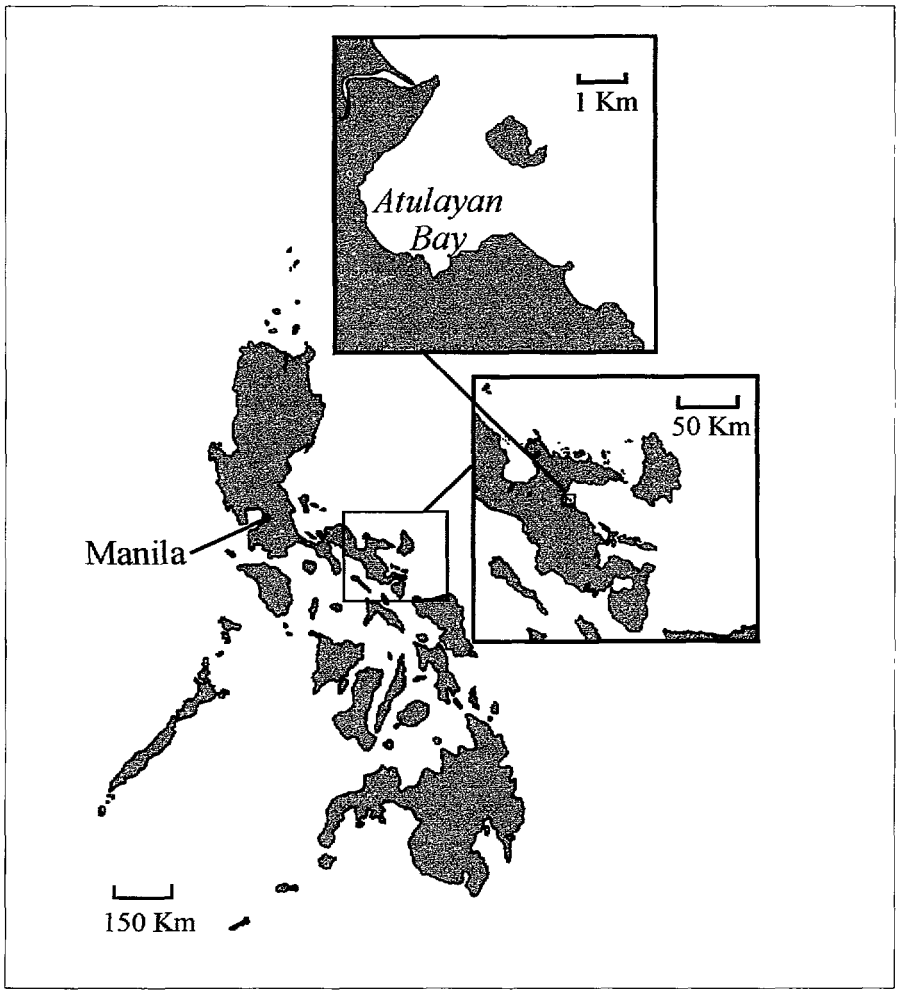

Figure 1. Location of Atulayan Bay and Lagonoy Gulf in the Philippines.

(PRIMEX 1993). During 1994 they deployed some 34 different types of gear to harvest an estimated 33,380 tons of the multi-species fishery resources of the gulf (Garces et al. 1995). Atulayan Bay is located in the western portion of the gulf, with Atulayan Island centered in the mouth of the bay. The bay has a number of coral reefs along the mainland and island shorelines, as well as between the island and the mainland.

HUMAN CONTEXT OF THE BAY

The municipality of Sagnay has jurisdiction over the waters of the bay. Seven barangays (villages) of Sagnay are coastal, and six are occupied by

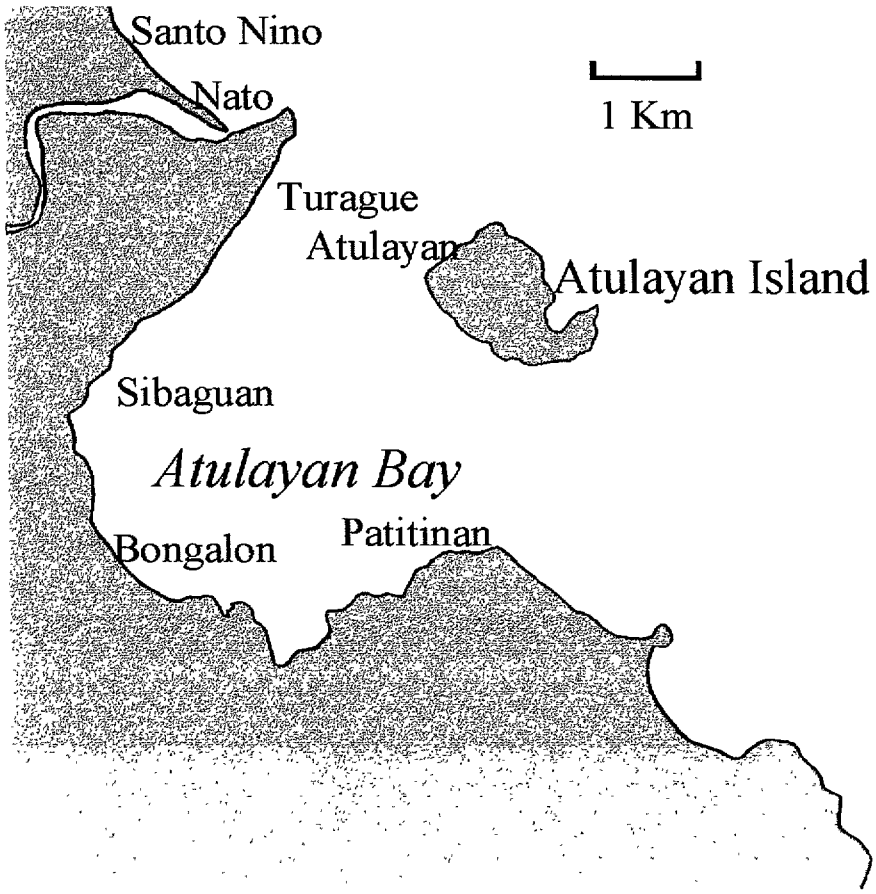

Figure 2. Locations of barangays in Sagnay.

fishers who harvest the waters of the bay. The one barangay which does not fish the bay (Santo Nino) is outside the bay, to the north. Santo Nino, however, has an incipient tourist industry which could impact the bay. Of these seven barangays, only one is predominantly occupied by fishers, Atulayan. Total coastline of Sagnay (including Atulayan Island) is 26 km. In 1994 there were a total of 421 fishers (Garces et al. 1995)[1], operating some 320 fishing vessels,[2] resulting in a density of 16 fishers and 12 boats per km of coastline. Total population of the coastal barangays was 9,240 in 1990 (NSO 1990), giving a population density of 355 per km of coastline.

From 1980 to 1990 the total population of Sagnay grew from 20,241 to 22,422 giving an average rate of growth of 1.1 percent per year. With respect to migration, PRIMEX (1993) conducted a survey of 90 households (random sample) from the coastal barangays of Sagnay[3] which indicates that 91 percent grew up in the municipality, 7 percent immigrated from within Camarines Sur and only 2 percent came from outside the province.

In terms of occupation structure, the PRIMEX survey (1993) indicates that of male heads of households, 35.5 percent identify themselves as principally farmers, 23.3 percent as fishers, 5.6 percent business, 5.6 percent government and 30 percent others (e.g., drivers, mechanics, laborers, construction workers, etc.). Of the wives, 15.6 percent reported income-generating employment: 14.3 percent each in fish trading, business and government. The remaining 57.1 percent employed are classified into an 'others' category including laundry woman, beautician, trader, etc.

Sagnay is quite homogeneous in terms of both ethnicity and religion. The PRIMEX survey indicates that 99 percent of household heads and 100 percent of wives are ethnically Bicolano while 98 percent of the wives and 96 percent of the husbands are Catholic. The others split evenly between Iglesia and

Table 1. Income distribution of household heads in coastal barangays of Sagnay.

Income '000P	Percent
0-05	7.8
5-10	21.1
10-15	1.1
15-20	12.2
20-25	17.8
25-30	15.6
30-35	0.0
35-40	13.3
40-45	2.2
45-50	1.1
50-Up	7.8

Source: Primex 1993:42

Protestant. There is quite a bit of diversity in terms of income distribution, however. Almost one-third of the households in the PRIMEX (1993) survey have incomes below 15,000 Pesos (P) annually, almost two-thirds (65.6 percent) below 30,000P (the reported poverty line for Region 5), and 92 percent below 50,000P (see Table 1, previous page).

With two-thirds of the households below the established poverty line, the quality of life is probably not up to national standards. When compared with the finding that fully 79 percent of families in the coastal barangays of Lagonoy Gulf fall below the poverty line, Sagnay looks a little better. The income figure also does not take into account home gardens, fish harvested for home consumption and bartering of production (e.g., trading fish for vegetables, etc.). Another indicator of quality of life is the infant mortality rate, which is relatively easy to acquire and is related to several other factors involved in quality of life such as income, education, nutrition and health. To calculate infant mortality rate, we recorded births and infant deaths (less than one year of age) from municipal vital statistics for a five-year period (1990-1994). Out of a total of 3,070 births recorded in the years 1990-1994, there were 33 deaths of children less than one year of age, resulting in an index of 10.7 per 1000.

Since the focus of this chapter is on human relationships with the reef, our focal interest for quality of life is among reef user households, in this case the fishers. Several barangay captains and other officials (e.g. the Sagnay medical doctor and the Municipal Agriculture Officer) were asked to compare the lives of fishers with non-fishers. Their responses were mixed, reflecting the diversity between the coastal barangays of Sagnay. For example, the barangay captain of Patitinan felt that fishers and farmers were similar. In her barangay, if fishing is bad, there is sufficient land for fishers to farm, and individuals move back and forth between the occupations and practice mixed strategies. Most felt that farmers were a bit better off than fishers because they own more property with value, but they noted that the producers in the best position were those who practice a mixed strategy–fishing and farming, depending on the season. The Sagnay medical doctor, however, noted that fisher families along the coast manifest more signs of malnutrition, attributing it in part to the incidence of gastrointestinal disease in the coastal area resulting in malabsorption. This observation probably holds for barangays like Nato, where the population is concentrated along the coast and river mouth, resulting in both a high water table and relatively constant dampness, providing a good vector for disease-causing organisms.

The coastal communities of Atulayan Bay. This section provides very brief descriptions of each of the seven coastal barangays of Sagnay. Similarities

and differences between these coastal communities will facilitate an understanding of the diversity of human adaptations around Atulayan Bay.

Atulayan. Barangay Atulayan, the only barangay on the island is located on the northwest shore. It is composed of several rows of mostly one- or two-room nipa huts, fronted by a white coral sand beach and backed by steeply rising, tree-covered hills. The only other residences on the island are at Baning Dakula and Baning Sadit, two isolated sand beaches on the southwest side of the island. There is one house at Baning Dakula owned by a resident of Naga who lives there only part of the year. There are two houses at Baning Sadit. Atulayan is the only coastal barangay of the municipality of Sagnay almost entirely dependent on the fishery for its livelihood. The total population of a little over 800 is divided among 122 households, all of which are classified as fishing households (January 1995 barangay census).

There is little room for agriculture, since the island's coast is backed by relatively steep hills and cliffs, but bananas, coconuts and some greens are grown in relatively small gardens for home consumption, and one small planting of maize exists on a steep hillside. Many families have several chickens, and a small number raise a few pigs. The only other economic activities or occupations in the community are around 10 *sari-sari* stores operated by fisher family members, four fish buyers, two primary school teachers, five boatmakers and two enterprising individuals who charge one Peso admission to view gasoline and diesel generator-powered VCRs.

There is no electric supply other than a few privately owned generators and no potable water supply in Atulayan. Water must be brought by boat from Lago, a *sitio*[4] in Turague on the mainland. Water for washing is obtained from a shallow well. A paved walkway extends through about 80 percent of the community which is nucleated linearly along the coast. There is no dock, and fishing vessels are landed directly on the beach. The marketing center for the residents of Atulayan is the municipal center of the municipality of Tigaon, the municipality just north of Sagnay along the shore of Lagonoy Gulf. For the most part, supplies are purchased and fish are sold in Tigaon.

The fishery consists of 79 boats (*baroto*), all double outrigger, plank and/or plywood built, ranging from about three to six meters in length. About 51 percent are powered by 12 to 16 horsepower, inboard gasoline engines. The rest are powered by paddle or sail. Principal fishing methods are *banwit* (hand line), *og-og* (hand line with multiple hooks and artificial plastic fiber or feather bait), *pana* (spear gun used by diver) and *sarap* (small seine net used to capture bait fish and other small fish and shrimp). Trolling, using *tora-tora* (wooden jigging lure with multiple hooks attached, targeting octopus, squid and cuttlefish) and *rambo* (feather lure, targeting pelagics) is

also practiced. Atulayan fishers use *tabao* (fish aggregating devices with bamboo and/or styrofoam floats) to aggregate fish for handline fishing in both shallow and deep waters (Gorospe and Pollnac 1997). Fish are usually landed anywhere along the beach and carried to be sold to one of the four middlemen who transport them to the central market at Tigaon, first via boat and then by jeepney.

Patitinan. Barangay Patitinan is the southernmost village in the municipality of Sagnay. Steep, mostly tree-covered hills back narrow coastal beaches fronted for the most part by coral reef, as well as some coral and stone outcrops. Only 40 percent of the barangay's hilly 902 hectares (ha) have been developed into farm land and 110 ha remain forested (PRIMEX 1993). The total population of 2,110 is divided among 403 households, 43 of which are classified as fisher households (December 1994 barangay census). Households are widely scattered over the hilly terrain, with some concentration along a paved walkway/road and the unpaved road which connects the barangay to the municipal center.

Most households are devoted to farming (some slash and burn). Most of the farmland is devoted to abaca, a plant from which abaca fiber is derived. Other crops, in order of area, include fruits, vegetables, coconut, root crops and a very small amount of rice (PRIMEX 1993). Farmers have ceased production of maize because it reportedly attracts an insect which attacks abaca. Other occupations include abaca stripping, abaca braiding (a cottage industry carried out by females) and firewood gathering. Four fish buyers (two male and two female) serve the 43 fisher households.

Fish are marketed in Tiwi, to the south, which is easier to reach than the municipal center of Sagnay. Sagnay is two hours away via jeepney during dry weather. The road is reportedly impassable during the rainy season. Five boats (15 passenger capacity) are devoted to transportation to and from this most isolated of the coastal barangays of Sagnay. There is no electric supply other than privately owned generators. A water supply project has resulted in the beginning of some piped water and standpipes at some locations in the barangay. A primary school serves local children.

The fishery consists of some 41 boats (see Note 2, the barangay captain reports 55 fishing vessels, 58 percent motorized, with some fishers owning more than one vessel) all double outrigger, plank and/or plywood built, ranging from about three to six meters in length. Principal gear types used by Patitinan fishers include *banwit*, *lambat, kitang* and *pana.* Fishers from other areas fish the nearshore areas with *pana, sarap* and *sinsoro* (beach seine). Patitinan fishers use *tabao* to aggregate fish for handline fishing in both shallow and

deep waters. Women and children glean the nearshore waters during low tide.

Bongalon. Like Patitinan, the fish landing beaches of Bongalon are partly fronted by coral reef and backed by steeply rising, tree- and brush-covered hills. A small amount of mangrove was observed along the coast. Only 13 percent of the barangay's 250 ha are devoted to farm land. Twelve percent is classified as forest (PRIMEX 1993). Households are relatively dispersed, with some concentration along the road and above some of the fish landing areas. The 1993 population of 600 plus is divided among 140 households, 40 of which are full time fisher households (1993 barangay census). The remainder are upland farmers and laborers. Farm products, ordered by area, are coconut, maize, fruits and a small amount of rice (PRIMEX 1993). Subsistence gardens containing various rootcrops (e.g., taro, cassava, etc.), greens and spices (chili peppers) were observed in association with individual dwellings. Fish buyers are located in Nato. Fishers either land their catch in Nato, or the buyers come to Bongalon.

Some households are linked to a spring-fed public water supply, and a few standpipes were observed along the road. Electric power lines along the road to the municipal center are being completed, and some three kilometers of the road are paved in the barangay, but most of the road to the north, through Sibaguan and Turague remains unpaved. Construction of a pier was completed in 1988 or 1989, but a steep, brush-covered hill leading to the unfinished road has led to its non-use and neglect, and it is slowly being eaten away by natural processes. The barangay has a primary school for local children. Limited supplies can be purchased from local *sari-sari* stores, but serious shopping must be done in the trade center at Tigaon, the municipal center to the north. This requires a trip via one of the twice daily jeepneys to Sagnay, then on to Tigaon via tricycle or jeepney.

Principal fishing types are *banwit, pana* and *sinsoro*. The poles for a fish corral were noted on a sandy area near the pier. This corral is reportedly the last legally permitted in Atulayan Bay. A fisher cooperative owns and operates a *kalansisi* (ring net unit) around *tabao* outside the bay. Shallow *tabao* are deployed in the bay to attract coral and other fish. Gleaning of the inshore rocky and coral areas is conducted by women and children.

Sibaguan. The topography near the coast of Sibaguan is hilly in the south and becomes a bit less hilly as one moves northward. The road from the municipal center is just a little above sea level close to the fish landing area with the greatest concentration of fishers. Households are mostly

dispersed, with some concentration close to the road, which is paved for a short distance through the barangay, but quickly becomes unimproved for the majority of the distance to the municipal center of Sagnay. A January 1995 house-to-house census counted 1276 individuals divided among 278 households. There is a great deal of conflicting information concerning number of fishing households.[5] Our best estimate is approximately 50 fisher households with the rest divided among farmers, farm laborers and a few carpenters. Approximately one-fourth of the barangay's 567 ha is classified as farm land and 9 percent as forest. Crops, in order of area devoted to agriculture, are coconut, maize, vegetables, root crops (cassava and sweet potato), fruits and rice (PRIMEX 1993).

Electricity lines have reached the barangay, and a public water supply pipes water to some households, with standpipes available for some others. *Sari-sari* stores are the immediate source of supplies, and residents must travel to the market at Tigaon for other than small purchases. A primary school is available for local children, the nearest secondary school being located in the municipal center.

Principal fishing methods include *banwit*, *panke* (gill nets), *rambo* and *og-og*. A few fishers use *banwit* around *tabao* in the deep. No gleaning was reported.

Turague. Barangay Turague is adjacent to the municipal center of Sagnay. Along much of the coast and in the northeastern part of the barangay along the Sagnay River, the coastal plain provides a contrast to the rugged topography further inland and to the south. The northeast corner of the barangay has some rolling hills, partly planted with coconut, which rise from the coast and the Sagnay River. In terms of total area, it is the largest of the coastal barangays, with some 2,600 ha, 84 percent of which is devoted to agriculture, most of which is coconut plantation (77 percent of the total area of the barangay), with some rice, maize, abaca, vegetables and fruits (listed in order of area devoted to production as derived from PRIMEX 1993). Less than 2 percent of the land remains covered by forest, in stark contrast to the coastal barangays to the south along Atulayan Bay.

The 1995 population of 2,500 is spread among 520 households (municipal records) which, for the most part, are widely dispersed across the large barangay with only slight concentration along the largely dirt road which leads to Sagnay. Only short portions of the road are paved. Major occupations include fishing (approximately 40 households, estimated from number of boats) with most of the remainder of the households devoted to farming and farm labor. It was reported that there is no cottage industry at all. Electric lines have reached the barangay. Residents obtain water from springs. A

spring located in Sitio Lago is the source of the potable water supply for Barangay Atulayan. *Sari-sari* stores are the immediate source of supplies, and residents must travel to the market at Tigaon for other than small purchases. Two primary schools are available for local children, the nearest secondary school being located in the municipal center.

Principal fishing methods include *banwit* (in the open and around *tabao*), *og-og*, *panke*, *sinsoro* and *pana*. It was reported that Turague fishers usually deploy about 15 *tabao* in Atulayan Bay by the beginning of March. These *tabao* are reportedly deployed in depths of 20-35 *dupa* (arm span–one *dupa* is approximately five feet).

Nato. Nato is located on a broad, flat coastal plain, at the mouth of the Sagnay River. The population of 2,276, divided among 421 households (NSO 1990), is concentrated along the river and the coast, forming the largest and most concentrated population of the coastal barangays of Sagnay. Much of the residential area is backed by rice fields. Fully 96 percent of the barangay's 375 ha is devoted to agriculture. Crops, in order of area devoted to culture are coconut, rice, vegetables and fruits (PRIMEX 1993).

The barangay is adjacent to the municipal center to which it is linked by a newly constructed cement road. The road leads directly from a deep water pier which was in final stages of construction in February 1995. The barangay has electric service, piped water and numerous *sari-sari* stores. Pedicabs, tricycles and jeepneys provide almost constant service to the municipal center. Tricycles and jeepneys run frequently over the paved road linking the municipal center to Tigaon, the local trade center. A fishery school as well as both a primary and secondary school are located in the barangay. A resort, constructed by a Swiss national, consisting of one house and several cottages recently failed. The major occupations are farming and fishing, with some 63 households devoted to fishing (estimate based on number of fishing boats). Other occupations include rickshaw, tricycle and jeepney drivers; furniture, wig, charcoal, brick and boat making; fish processing and trading; and stevedoring.

The latter occupation, stevedoring, was facilitated by the Nato Multipurpose Development Cooperative as an alternative to fishing. This multipurpose cooperative was founded in 1993 as a part of the Fisheries Sector Program, and its infrastructure includes a fish landing area and a building for administration and meetings. Another NGO is the Nato-Santo Nino Multipurpose Cooperative, which focuses on agricultural product pricing.

The Nato fishery consists of some 63 municipal boats. Predominant gears include *banwit* (in the open and around *tabao*), *og-og*, *kitang*, *pangke*, *sinsoro* and *pana*. There are also about seven ring net and six bag net operations

(Garces et al. 1995). The only other ring net operation in Sagnay is associated with the cooperative at Bongalon (see above). Gleaning is done on the rocks and in the sand and remaining coral at the mouth of the Sagnay River.

Santo Nino. Santo Nino, like Nato, is situated on a flat coastal plain, with 41 percent of its 164 ha devoted to agriculture, mostly rice, with a very small amount of coconut, maize, vegetables, fruits and root crops (PRIMEX 1993). Population in 1994 was reported to be 1,027 divided among 130 households (1994 barangay census). The barangay captain estimates that 25 percent of the households are fishers, 60 percent farmers and the other 15 percent following a mixed strategy of farming and fishing.

Connected to Nato and the municipal center with a partly paved and partly dirt road, Santo Nino has both water and electricity service. Several *sari-sari* stores provide daily needs, and jeepneys, tricycles and rickshaws provide transportation services, linking the community with the municipal center. Caretakers of an estate owned by a non-resident rent beach shelters to visiting Filipino or local tourists. Santo Nino fishers provide transportation to Atulayan Island where other day rentals of beach shelters are available. The barangay has two NGOs, the Nato-Santo Nino Multipurpose Cooperative which is composed mostly of farmers, and the Santo Nino Multipurpose Cooperative, registered in January 1995, composed mostly of fishers.

Fifteen municipal fishing vessels are owned by Santo Nino fishers, only three of which are motorized. Additionally, a Nato ring net operation is crewed by Santo Nino residents. Commonly used gears include *banwit, og-og, panke* and *sinsoro*. There is no coral reef off Santo Nino, and net fishers operate over the sandy bottom, just several meters from shore. A gill net was observed near the mouth of a small creek flowing into the Gulf. Fishers do not fish the waters of Atulayan Bay which is south of their barangay. When they fish offshore, they fish the open waters of Lagonoy Gulf.

USE OF THE CORAL REEFS

At the present time fishing, gleaning and a very small amount of tourism constitute the only direct uses of the coral reefs of Atulayan Bay. In the past, it was reported that coral was removed for building purposes, but informants deny that this is being done at the present time, and no evidence of active mining was observed during the research reported here.

TOURISM

Atulayan Bay has a great deal of natural beauty, with its azure waters, coral reefs and both white and black sand beaches. Contributing to this beauty is the varying terrestrial topography, ranging from forested mountains climbing steeply from water's edge, to the coastal flatlands at the northern edge of the bay where the Sagnay River enters the sea. Mount Isarog, its top shrouded in cloud, forms a dramatic background that can be viewed from almost anywhere in the bay. Although these natural features have a great deal of potential for attracting various types of tourists, this has not been realized. This is perhaps due to the fact that the nearest location with air service is Naga City. From Naga City, one must travel by bus or jeepney to Tigaon, then by jeepney or tricycle to Sagnay–a journey of two hours or more. Further, in the coastal barangays, where the beauty of the area can be appreciated, there are no hotels or restaurants.

A European built a small resort at Nato, comprised of one house and several cottages on the coast, but it failed. Near the border between Santo Nino and Nato, a non-resident landowner built a vacation house with several beach shelters. The caretakers rent the beach shelters to Philippine tourists, mainly during March through May. Local fishers offer to transport tourists to Atulayan Island for a small fee. On Atulayan Island, a resident of Naga has constructed a vacation house with several beach shelters on a relatively isolated white sand beach. Barangay Atulayan has also constructed several beach shelters on this beach. Small fees are charged for the use of the shelters, and during the research period, Filipino tourists were observed at these shelters, using the beach, hiking around the island, swimming and walking on the coral every weekend. Numbers were small, five to 10 at a time, but larger numbers are reported using the facilities during holidays. As the society becomes more affluent, and as transportation to the area improves, the numbers of users and services will probably increase.

FISHING AND GLEANING

Fishers of Atulayan Bay target both coral and non-coral fish. Even when targeting non-coral (e.g., when targeting pelagics such as tuna around the fish aggregating devices [*tabao*] just off Atulayan Island in Lagonoy Gulf), they capture grouper (*baraka'*) and other coral species; thus, having an impact on the coral reef community of fish. Gleaners also collect from coral areas (especially off Patitinan and part of Atulayan Island) and rocky shorelines.

Technology and methods. Much of the fishing, except for gleaning, involves some use of boats. Most of the fishing boats (*baroto*) are double outrigger, plank and/or plywood built, ranging from about three to six meters in length. Less than half are powered by 12 to 16 horsepower, inboard gasoline engines. The rest are powered by paddle or sail. Vessels used by ring net fishers are larger, ranging from a little under to more than three gross tons.

Fishers and gleaners of Atulayan Bay use a wide variety of gears. They glean by hand or with a short metal blade (*humol*) to pry mollusks from the rocks. Spear guns (*pana*) are used by divers on the coral reefs. Hand lines of various kinds are used, the most common being those with single hooks (*banwit*), multiple hooks (*og-og*), and the use of various lures (*tora-tora, rambo*). Pole and line fishing from the shore was occasionally observed. Bottom-set long lines (*kitang*) were reportedly used mainly by fishers from Nato and a few from Patitinan. Some fishers tie a string around an underwater rock and attach a rubber band with a baited hook attached to capture coral reef fish. This technique is referred to as *pahulad.*

Of the nets used, gill nets (*panke*, monofilament for the most part) were most commonly observed, including bottom set (*palubog*) and drift (*palutang*). *Kuralon*, a net made of brownish cotton thread, is used to catch small *turay* as well as some other fish at night. Various seines, including the beach seine (*sinsoro*), small seine nets used for bait fish (*sarap*), and the ring net (*kalansisi*) were observed and reported being used. A beach seine referred to as *kunay* is used with scare lines (a nylon cord with straw material attached or a coconut frond) which drive the fish into the net. Only a few bag net (*basnig*) fishers reportedly operate out of Nato. Occasionally, transient fishers from the Visayas use scare lines to frighten fish from the coral into a net. This technique is referred to as *wuswos* and usually involves 10 fishers in the water with the scare line. Scoop nets (*silo'*) are used in combination with a poison (*tubli*, from the pounded root of a tree) which is used to stun fish concealed in coral. Illegal techniques (e.g., sodium cyanide poisoning or stunning and blasting with explosives such as dynamite) are also reportedly used to extricate fish from the coral reefs.

Only one fish corral (*baklad*) operator had a lease on a sandy area just off Bongalon, but it was not in operation at the time of the research. Only the stakes outlining the corral remain in the water. Hand line (*banwit*), ring net (*kalansisi*) and bag net (*basnig*) fishers use fish aggregating devices (FADs, *tabao*) to aggregate target species.

Selected aspects of frequently used techniques as well as techniques potentially damaging to corals are discussed in following subsections. Individuals interested in more technical discussions are referred to Garces et al. (1995) and BFAR (1988).

Handlines. *Banwit* is the fishing technique most frequently used by fishers of Atulayan Bay. *Banwit* refers to a single, weighted hook and hand line. The technique for deploying the *banwit*, however, is of potential significance and has not been described in other reports for Lagonoy Gulf (e.g., Garces, et al. 1995). It is used over all types of bottom, including coral.

The *banwit* operation frequently includes an ingenious deployment of chum along with the baited hook. Fishers carry smoothly rounded, oblong rocks (*palos*), approximately seven to eight inches long and four to five inches wide for fishing around tabao in waters over 50 *dupa* deep. Somewhat smaller rocks are used in shallower waters and over the coral reefs. These rocks, usually near white, are collected along the shore and are probably wave worn pieces of the reef. The bait fish is cut into small pieces. One whole fish or a piece is put on a weighted hook, and other pieces (the chum) are bound to the rock with several wrappings of the fishing line. The fishing line is then tied with a special knot that will release with a jerk of the line. The combination, hook, bait, chum and line are thrown overboard, and when the fisher judges that it has reached the appropriate depth, the line is jerked. This releases the line wrapped around the rock, which releases a cloud of chopped bait fish as it unwraps, and the weighted, baited hook is deployed within the chum. The rock falls to the bottom where we imagine it is creating a new habitat and grounds for speculation by future archaeologists. This is done an average of 30 times per fisher, per trip, using about one to two kilograms of bait. Local fishers refer to this technique as *wagwag*, the term used to refer to the process of shaking the dust out of a fabric (e.g., clothing, blanket, etc.). It is a simple handlining operation. No rods or winches are used. The line is kept on a wooden spool, and bringing the fish onto the boat is effected by pulling the line by hand, hand over hand. Another type of handline frequently used is the *og-og*. *Og-og* usually have 10 or more hooks attached (Garces et al. 1995 report 20-30 hooks). Hook size depends on the size of target fish, but those observed were relatively small (approximately one-half centimeter). Attached to each hook is a piece of synthetic fiber (green, white or red). Color used depends on target fish and time of day (day or night). Target fish are usually Carangidae.

Net fishing. The most frequently used net types are monofilament gill nets, both bottom set (*palubog*) and drift (*palutang*). Both of these types of nets are used near and over coral reefs as well as in other areas. These nets are usually about two meters by about 20 to 80 meters in size. While the deployment of gill nets is well known, there are several important points with respect to potential impacts on the resource. First, observed mesh size is relatively small (3/4 to 1 inch square). Some of the target fish are too large to

be gilled in such small nets, and fishers report using them as tangle nets for larger fish. But, juvenile fish are captured and kept as well. Second, when bottom-set nets are deployed over coral, the weights are dropped on the coral surface with potential for damage. Boats, however, are reportedly anchored to the net anchor line. Third, when divers are deployed to frighten fish into the net (a technique referred to as *kampag*), they reportedly just use the movement of their bodies and sometimes an oar to scare the fish, but they can damage the coral if they walk on it.

Another frequently used net is a small seine net (*sarap*) used for bait fish as well as *maripati* and *kuyog*. *Sarap* were observed being deployed on the coral as well as on sandy bottom around Atulayan Island. These nets are deployed a few meters from shore. One fisher stands in the water, holding one end of the net, while the boat attempts to encircle a school of bait fish by pulling the other end of the net around the school. An oar is splashed in the water or tapped on the bottom to scare fish into the net. Another net having potentially damaging impact on reef fish is the bag net (*basnig*). While the main target of the *basnig* is anchovies (*bulinao*), they also target *kuyog*, just-hatched *bataway* (*Siganus lineatus and S. spinus*). *Kuyog* are used to make *bagoong* (fermented fish paste), and must be captured before they eat their first meal to make the best product.

Fish aggregating devices. Inexpensive, but effective FADs (*tabao*) form an important part of the Atulayan Bay fishery. Those set just off Atulayan Island and in the bay attract coral fish along with other species. The floats for the *tabao* are constructed of bamboo or styrofoam or a combination of the two. When bamboo is used, 10 to 15 poles are required, resulting in a float approximately three by one *dupa*. The anchor is a large stone of 50 to 250 kilograms, depending on depth. The anchoring cable is five strand, one centimeter, multifilament synthetic (polyethylene) rope (trade name and size–Evelon #16). Coconut fronds are attached to the anchor line for several *dupa* at about 15 *dupa* below the surface. The fronds are replaced at monthly intervals. Just below the level of the coconut leaves, the anchor line is knotted (no shackles are used) so that the upper portion, including the leaves and the float, can be moved to accommodate net fishers.

Fishers of Atulayan Bay have placed *tabao* just off the reef wall and in deeper waters on the Lagonoy Gulf side of Atulayan Island. Those just off the reef wall are at depths from 70 to 100 *dupa*. Those farther out are in depths greater than 500 *dupa*. In Atulayan Bay, *tabao* are set in depths from about 20 to 50 *dupa*. Although tunas and mackerels (Scombridae) are the target fish for *tabao* outside Atulayan Bay, Carangidae, Lethrinidae, Lutjanidae and Serranidae are frequently landed as well. In Atulayan Bay, the *tabao*

aggregate mostly Carangidae, Engraulidae (anchovies) and some mackerel. While most of the fishing around the *tabao* is conducted with handlines, ring netters (*kalansisi*) occasionally use those both inside and outside the bay, and bag net (*basnig*) fishers target anchovies around the *tabao* in Atulayan Bay.

Gleaning. While the fishing techniques described above are almost solely conducted by men,[6] gleaning is done mostly by women and children. Gleaning makes an important contribution to nutrition when the catch is low as well as providing a welcome change in diet. Gleaning is conducted at low tide, in nearshore rocky and coral reef areas. The only equipment used is a knife blade or other strip of metal which can be employed to pry organisms loose from the rocks or coral. In areas such as Atulayan Island, Patitinan and Bongalon this involves walking on the coral, with potential for damage.

Important target species. Important target species were determined through use of key informants.[7] At least one fisher and/or fish buyer from each of the six coastal barangays fishing the waters of Atulayan Bay was requested to list the five most important coral and five most important non-coral fish caught for sale and home consumption. Eleven key informants were involved in this process. Fishers were representative of major gear types used (e.g., gill net, handline and diver). Sometimes non-vertebrates were included in the lists, and these were ranked separately from the vertebrates in the analysis below. It is important to note that the categories 'coral' and 'non-coral' used here are as defined by the fishers themselves. These do not necessarily reflect categories used by coral reef scientists. Gleaners, from communities where gleaning was practiced, were asked to list the types of non-vertebrates gleaned. Four key informants provided information concerning types gleaned. Types were entered into a cumulative list along with their relative rank order (position in the individual informant's list, which is an indicator of relative salience or importance). Hence, number of individuals designating a given type as important, as well as list position, was available for use in identifying the 'most important' types.[8]

Most important non-coral fish for income are: 1) *bangkulis* (*Thunus albacares*); 2) *bulinau*[9] (*Stolephorus sp.*); 3) *sibubog*[10] (*Decapterus sp.*); 4) *tangigi* (*Scombridae sp.*); 5) *matangbaka*[11] (*S. crumenopthalmus*); 6) *malasugi* (superordinate term for swordfish and marlin);[12] 7) *buraw*[13] (*Rastrelliger sp.*); 8) *salay-salay* (*Alepes djedaba*[14]); 9) *lamadang* (*Coryphaena hipporus*); and 10) *pundahan* (*Katsuwonus pelamis*). Most important coral fish for income are: 1) *baraka'* (superordinate category for most Serranidae); 2) *linhawan* (superordinate category for Scaridae and Labridae); 3) *bataway* (*Siganus sp.*); 4) *suga* (*Myripristis sp.*); 5) *roskita* (*Caesio sp.*); 6) *mungit*[15]

(superordinate category for *Acanthurus sp.* and *Naso sp.*); 7) *timbungan* (*Parupeneus sp.*); 8) *tiki'* (*Saurida sp.*); 9) *bokawon* (*Lethrinus lentjan*)[16] and 10) *hanapos* (*Seriola dumerili*).

For the most part, fish listed as important for food were similar to those listed for income. The most common qualification applied to coral fish was that small ones would be used for home consumption. With regard to non-coral fish, parts of the fish would be used for home consumption (e.g., the guts of *bangkulis*, the head of *malasugi*, a small portion of *tangigi*, etc.). This type of information is difficult to convert to reliable ranks.

Invertebrates elicited in the coral fish listing procedure are: 1) *cogita* (Octopus sp.); 2) *kulambutan* (*Sepia sp.*); 3) *pisay* (Bivalve, unidentified); 4) *manglot* (*Tridacna squamosa*); 5) *kanoos* (*Sepioteuthis lessoniana*); and 6) *balat* (*Actinopyga sp.* superordinate term for sea cucumbers).

According to informants, only *tagat-i* ('shellfish') and sea urchins are gleaned. The *tagat-i* listed by gleaners are: 1) *locog*; 2) *lapas-lapas*; 3) *sahang*; 4) *pisay*; 5) *bulansungan*; 6) *kod-kod*; 7) *tarukog*; 8) *liswit*; 9) *samong*; 10) *rapuganay*; 11) *bugitis*; 12) *manglot*; 13) *buskay* (cowrie); 14) *hamudyong*; 15) *bugat*; 16) *mod-bod*; 17) *barisara*; 18) *sinaldaw*; 19) *buhuan*; 20) *talaba* (oyster); 21) *sarag*; 22) *sarad*; 23) *bahian*; 24) *tanggulong* (chambered nautilus); and 25) *tabaguang*. Only two types of sea urchins were named in lists obtained from gleaners: *tayong* (a black sea urchin) and *ogob-ogob* (a 'furry' sea urchin).

It was difficult to obtain reliable figures concerning the relative importance of the different types of fish; hence, the most accurate level of measurement does not exceed an ordinal level. All informants agreed that fish they classified as non-coral are more important for food and income than the coral fish. Estimates ranged around 20-30 percent for coral and 70-80 percent for non-coral. The most marked seasonality occurs with respect to the tunas, beginning around January and ending in April. Some of the other fish from non-coral areas are captured up until October. Coral fish are captured year-round, but are the focus of attention in the period when tunas and mackerels are absent. Divers focusing on coral fish like to fish when the weather is warm and the water clear (May to September or October). The worst fishing occurs around August and December. During periods of low catches (especially November through much of January and sometimes February), gleaning provides much of the animal protein for fisher families. Considering the relatively brief period when non-coral fish peak in terms of production and the relative importance of gleaning (frequently from coral)

during the poor fishing periods, as well as the year-round availability of coral fish, it is clear that the coral reef is significant for both the income and nutrition of the fishers of Atulayan Bay.

Distribution and marketing. Fishers are often tied to buyers through the provision of bait or towing services. This relationship does not appear to be exploitative. There are several buyers in each coastal barangay; hence, there is opportunity for competition. The buyers also live in small communities, having daily face-to-face interaction with most of the fishers and their families–a situation not conducive to exploitative relationships. Through time, these buyers have established practices that most participants perceive as fair. Profit per kilo is usually between five and 10 Pesos. It was reported that it is unusual for there to be a disagreement over prices paid for fish, and that it is not a good practice to offer too low a price. It was stressed, however, that in the very unusual situation where the fisher feels the price offered is too low, he can sell elsewhere.[17]

While buyers usually obtain sole buying rights from fishers through the provision of bait, there are times that fishers can easily obtain bait themselves. This is during the period of full moon when bait fish are easily caught. During this time, buyers go out to harvesting areas to buy fish directly from fishers at sea. Buyers performing this activity are referred to as *bangal*. For example, the buyer from Atulayan ties up to the *tabao* along with the fishers, and when fish are caught, the *bangal* makes an offer for the fish. If the price is acceptable, the fisher sells to the *bangal*; if not, he sells elsewhere. Prices paid by *bangal* at the *tabao* are about 5 percent higher than those paid at the fish landing.

The fish harvested by the fishers of Atulayan Bay are not sold in the international marketplace. Sea cucumbers were bought by big buyers in Legaspi and Naga, but this market seems to have reduced in importance. Post-harvest handling and distribution of fin fish is negatively impacted by the lack of cold storage and inadequate transportation links. Hence, fish are consumed in the coastal barangays or sold in the local marketing center of Tigaon (the municipality just north of Sagnay). Ice is not used for transportation to the landing areas and rarely used for transporting from the landing to the market. Fish could arrive at the Tigaon market, having no cold storage in a tropical climate, more than 10 hours after capture. The potential for bacterial growth results in fish of questionable quality for further distribution into the national or international marketplace. The fishers and coral reefs of Atulayan Bay, hence, contribute to local nutrition and income.

REEF GOVERNANCE

LOCAL KNOWLEDGE

While governance of a natural resource is most frequently associated with formal, official government regulations, it is the community of resource users who exercise the most direct control over the resource and who, in their perception, have the most to gain or lose from changes in availability. Their perceptions of the resource, as well as the ecological knowledge they have gained from generations of interaction with and dependence on the resource, have a direct influence on their resource-related behavior. Ecological knowledge of users is a factor increasingly recognized as both influencing receptivity to and providing information significant for governance (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Johannes 1981), use rights and actual management efforts (traditional and/or official), if any.

Local ecological knowledge is related to reef governance in several important ways. First, local knowledge concerning the reef and its associated flora and fauna can contribute to our scientific understanding of this complex ecosystem. Second, an understanding of local knowledge systems can facilitate interactions between reef users and outsiders (e.g., scientists, management specialists, decisionmakers, etc.) concerned with reef issues. Third, knowledge of local belief systems concerning human relationships with reef flora and fauna may help predict and explain reactions to management efforts (see Chapters 1 and 2).

Cognitive mapping. One important aspect of local knowledge includes user conceptualization of the distribution of the resource, including cognitive mapping. While distribution of a resource is a spatial phenomena, reference points in the spatial distribution are converted into concepts which are frequently named, especially if they are important reference points. Hence, users' cognitive maps of the distribution of the resource can be constructed, in part, from named features, fishing spots, etc. Place names elicited from the fishers of Atulayan Bay can be found in Figure 3.

In some cases the locations in Figure 3 are named after a *sitio*, which is a named division of a barangay. For example, Boyoboy is a *sitio* of Patitinan which has a coral reef along the shoreline. Maputi is a *sitio* of Turague which has a white sand beach (*puti* = white). The fishing spots of Maputi are further classified by identifying features nearby (e.g., *halangkaw na bulod* [high mountain] and *duwang pu-on na niyog* [two coconut trees]). Some locations have distinguishing features, such as an abundance of a certain plant species.

One of the cliff walls of Atulayan Island is referred to as Katanglunan, which is derived from *tanglon*, a creeping plant found at this location. In other cases a place may be named after a resource concentrated at the spot. For example, Tarasingan is a spot at 27 *dupa*, (75 meters) off Barangay Atulayan. The name is derived from the fish found there, the *tarasi'* (*Lutjanidae lineolatus*).

Other terms are used to define boundaries or more general areas. For example *laog* is a term used to refer to the location 'inside' the bay. The southeast boundary of the bay is defined by a line referred to as *garang*, which extends from a point between Buntugan (a cove) and Upaw (an area with caves and a cliff wall with outcrops) on Atulayan Island to Gorda Point (Sitio Santa Cruz, Patitinan). As one moves out into Lagonoy Gulf beyond Atulayan Island, the drop-off to the deep is referred to as *kantil*, and beyond that is *laot*, the sea. Fishers from Atulayan refer to the coral reef drop-off where a frequently used *tabao* is located as *Kapangpangan*. With regard to coral reefs, several terms were used by the fishers of Atulayan Bay which they said were equivalent. *Gasang* refers to coral, and *gasangan* refers to a coral reef. It was also reported that the terms *bahura*, *sapaw*, and *tulong* refer to coral reef.[18] All of these terms form an important part of the ecological knowledge of the fishers of Atulayan Bay. They serve to provide a cognitive map for organizing their behavior with respect to the organisms in the bay; hence, they can play an important role in local resource management.

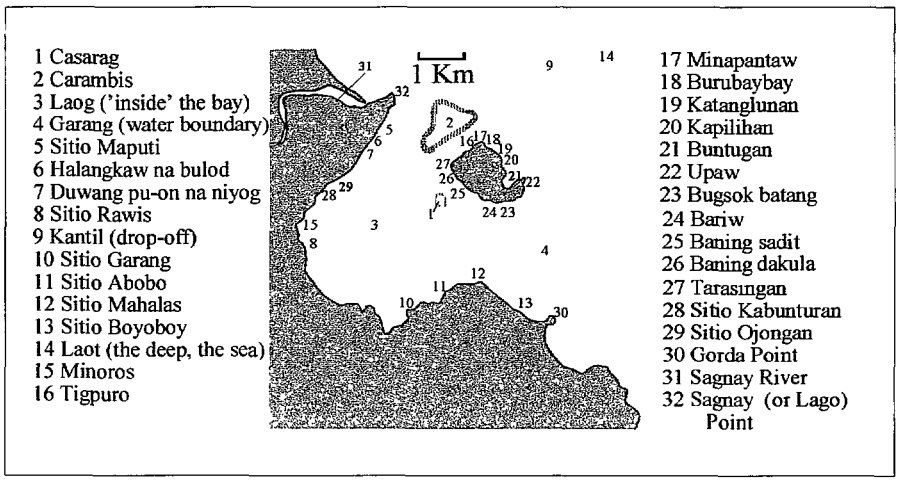

Figure 3. Local place names in Atulayan Bay.

Folk taxonomy. Another important aspect of Atulayan Bay fishers' ecological knowledge is naming and recognition of aquatic organisms. The number of aquatic organisms distinguished and named by these fishers is truly enormous, reflecting both the extent of traditional knowledge they possess (cf. Johannes 1981; Pollnac 1980; Ruddle 1994) and the species diversity characteristic of coral reef areas.[19] The folk taxonomy found in Appendix I of this chapter lists hundreds of marine vertebrates and invertebrates distinguished by the fishers of Atulayan Bay. It is referred to as a 'folk taxonomy' to reflect the fact that it is a list of names shared by a community of fishers in contrast to a 'scientific taxonomy' which is usually shared by an international community of scholars. Both types of taxonomies, however, are based on observations of similarity and difference; both are based on a type of science–the folk taxonomy on folk science, the 'scientific taxonomy' on internationally established scientific procedure.

Folk taxonomies, however, reflect more than a listing of names. They also reflect processes by which humans organize the diversity in their environment, and this organization of diversity is frequently influenced by other social and cultural variables (Berlin 1992; Brown 1984). The most obvious, long-recognized example of this process is the observation that taxonomic categories with cultural significance are frequently characterized by a large number of named subcategories (Berlin et al. 1966). For example, staple crops are characteristically subdivided into a relatively large number of named types among traditional farmers; people concerned with snow (e.g., skiers or Eskimo) have more named varieties of snow than others. Likewise, the fishers of Atulayan Bay have more named types of fish (*sira'*) than non-fishers. Although fish dealers know many types, their knowledge does not equal that of the fishers, and they frequently refer to the types using higher level (or more general) taxonomic categories, more often than not in Tagalog which is more useful in the marketplace. If a number of species manifest similar culinary attributes the dealer and consumer need not refer to them by specific type (e.g., hammerhead shark) but need only refer to them in terms of a more general category (e.g., shark).

These more general categories also function to facilitate learning and memory. They cluster types which share some features in common into groups, and the name of the group, which elicits in memory the features shared in common, also acts as a key, or mnemonic device for stimulating recall of the specific types. Once again using the 'shark' example, a child probably learns the term 'shark' first,[20] then learns that there are other types of shark. In this case, the superordinate category functions to organize the complexity of more specific categories in the taxonomy. Both of these processes (simplification of complexity where details are not needed and organization of complexity to

facilitate learning of the details) appear to be reflected in the folk taxonomy of aquatic organisms used by the fishers of Atulayan Bay.

From this point forward, certain conventions will be adhered to with respect to terminology used in describing the folk taxonomy of the fishers of Atulayan Bay. Levels in a taxonomy will be referred to as ranks. Shark is a taxon at a more inclusive rank than the taxa hammerhead shark and nurse shark. The term 'shark' refers to more organisms than the term 'hammerhead shark,' hence, it is considered more inclusive. The high degree of similarity between folk taxonomies and scientific taxonomies has led anthropologists to use many of the same terms as biologists in describing the structure of folk taxonomies (cf. Berlin 1992). For example, anthropologists use terms like 'generic rank' and 'specific rank.' These are not always coterminous with the biologist's application of the terms because folk taxonomies have fewer ranks;[21] hence, the terms will be modified by the term 'folk' in this report. When referring to the generic rank in a folk taxonomy, it will be labeled 'folk generic,' etc.

A good example of the organization of the folk taxonomy of the fishers of Atulayan can be provided by examining the taxon *baraka'* (Serranidae, rock cods/groupers). In their list of fishes and invertebrates observed in Lagonoy Gulf, January to December 1994, Dioneda et al. (1995) list 22 Serranidae, 20 of which appear in their list of commercially important fishes. The local name for 19 of these distinct species is reported as *baraka'*. For the fishers of Atulayan Bay, *baraka'* is one category of *sira'* (fish). *Baraka'*, however, is a taxon at the folk generic rank,[22] such as the terms 'shark' or 'trout' are in American English folk taxonomies.

Thirteen different specific rank taxa of *baraka'* were elicited as part of the folk taxonomy: *alang, amidon, banolog, dugnitan, durog, kugtong baraka', lana', lapug, taga-rinas na baraka', pulang baraka', tangka', turukturukan* and *ugapo'*. Further, the folk specific taxon *ugapo'* was divided into four folk varieties, two of which were named (*bulaw* and *abuhon*) and two unnamed (simply referred to as *ugapo'*), but recognized taxa, one described as *batik* (mottled) with black and the other as having a color similar to a rock when alive. Likewise, *banolog* was divided into two folk varieties, *kabang* and *banolog*. One folk species, *kutong baraka'*, had a distinct term applied to the juvenile form, *ngipaon*. This large number of named types at both the folk specific and varietal levels suggests that *baraka'* is a culturally significant category of coral fish. Berlin et al. (1973) note that contrast sets with more than two members on the varietal level tend to refer to organisms of major cultural importance. In fact, as was indicated above, *baraka'* is identified as the most important coral fish for income. The significance of *baraka'* in the marketplace is also indicated by the fact that the type is frequently referred to

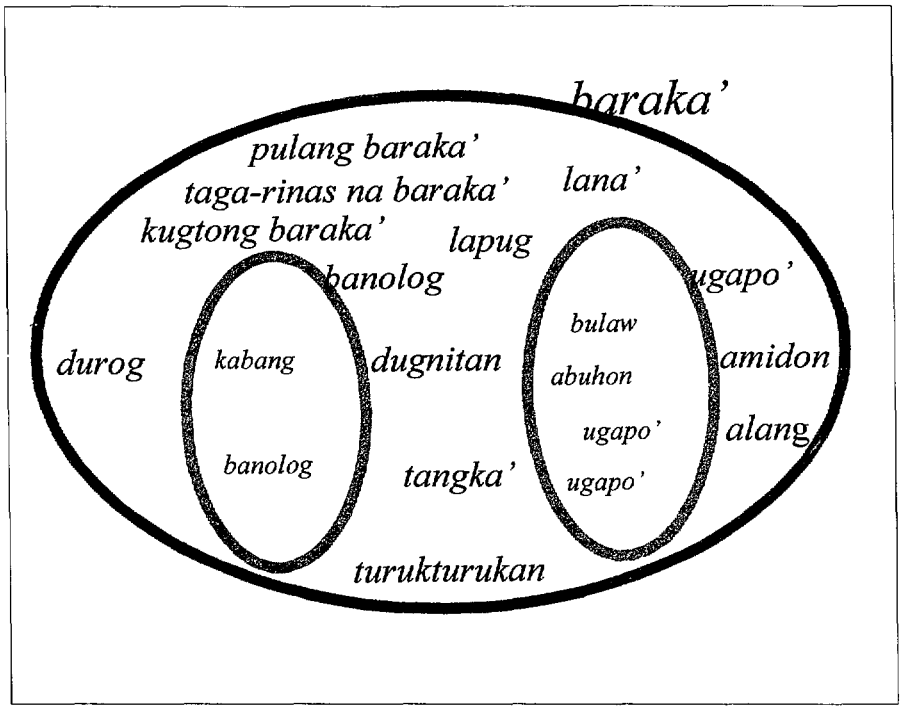

Figure 4. Diagram of the folk taxonomic structure of *baraka'*.

as *lapu-lapu*, the Tagalog term for many Serranidae. The taxonomic structure of *baraka'* is diagrammed in Figure 4.

The use of the Tagalog term as an alternate label for economically significant categories is also illustrated by *dalagang bukid*, a superordinate term to refer to a number of Caesionidae (fusiliers) by the fishers of Atulayan Bay. The Bicol term for *dalagang bukid* is *roskita*. At the next lower rank in the folk taxonomy of *roskita* (*dalagang bukid*) we find eight folk specific taxa: *roskita, sulig* [*solid*], *anduhaw, hamil-hamil, hiringhitin, kilaw-kilawan, lambadoc* and *tipil*. *Roskita* is also identified above as one of the economically significant coral fish, its economic significance being reflected in the large number of taxa at the specific rank.

It is also significant to note that most of the taxa at both the folk specific and varietal levels for *baraka'* and *roskita* are labeled by primary, as opposed to secondary names. Secondary names are linguistically complex, with one part indicating the superordinate category. An example of a linguistically complex secondary name for a fish in English is hammerhead shark. An example from the taxonomy of *baraka'* is *pulang baraka'* (or *barakang pula*),

the direct translation for which is 'red baraka.' Sub-folk generic taxa are usually labeled by secondary names. Berlin (1992) notes that when primary names are used to label folk specific taxa, the species involved usually have high cultural importance.

Sometimes the term used to label the folk generic rank is also used at the folk specific rank, such as we saw with respect to *roskita*, above. Frequently this term is used with a modifier *natural*, *puro* or *tunay*. For example, the folk generic term for the rays (Dasyatidae and Mobulidae) is *pagi*. At the folk specific rank under *pagi* we find *paging natural*, *banagun*, *banogon*, *oga-og*, *dalamugon* and *pasa-pasa*. In these examples, it can probably be argued that *roskita* and *pagi* at the folk specific rank are more prototypical, or best examples of the taxa included in the folk generic taxons *roskita* and *pagi*, respectively.[23] Most frequently the prototype shares more features in common with the other types in the same category (Rosch 1973), but other factors such as frequency of occurrence, cultural significance and relative perceptual salience also impact prototypicality (Berlin 1992; Bulmer 1979).

It is a truism in anthropology that cultural knowledge is unevenly distributed in any population; hence, one would expect intracultural variability in knowledge associated with a taxonomy as complex as the one used by the fishers of Atulayan Bay. Adequate investigation of this variability cannot be carried out within the time constraints of rapid appraisal, but an example can be illustrative of the difficulties involved.[24] The folk generic taxon *linhawan* can provide a good example. In an early stage of our research an informant was queried concerning *maming*, a Labridae (wrasse). He said it is a *linhawan*. He also classified other Labridae (e.g., *talad*, *maming*, *hipos*, etc.) as *linhawan* but included *angol*, the hump-head parrotfish (*Bolbometopon muricatus*, a Scaridae; see Figure 5) as a *linhawan*. A review of data collected several days previously, however, indicated that other informants identifying a picture of the hump-head parrotfish as *angol* sometimes use the Tagalog term *mulmol* for *linhawan*. In Tagalog, *mulmol* is identified as Scaridae. These informants noted that *linhawan*, other than *angol*, are classified by color at the specific rank and gave the examples *linhawang asul* (blue), *puti'* (white), *dilaw* (yellow) and *itim* (black)[25] all of which are Scaridae. Later informants added the folk specific taxons *buskayan* and *tamumol* to the types of *linhawan* and denied that any of the Labridae are *linhawan*.

The intracultural variation with respect to *linhawan* is probably due to the fact that except for major differences in dentition, there is some similarity in form, color, and habitat between many of the Labridae and Scaridae. They are, in fact, descended from a common ancestral stock (Bruggemann 1994). *Angol* provides a good example of the similarity between the two. Dioneda

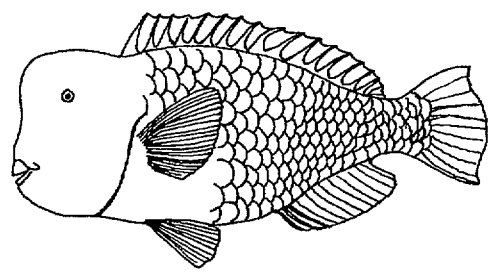

Figure 5. Humphead parrotfish (adapted from Smith and Smith 1963).

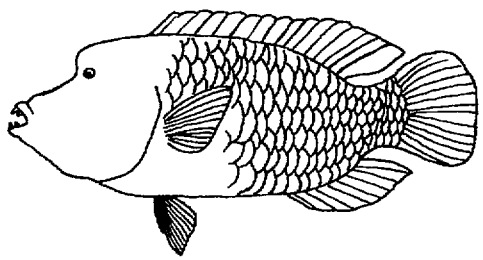

Figure 6. Napoleon wrasse (adapted from Marshall 1966).

et al. (1995) identify *angol*, as used in *Camarines Sur*, as *Cheilinus undulatus, C. fasciatus* and *Thalassoma lunare* (all Labridae or wrasses). *C. undulatus* (Napoleon wrasse or Napoleon humphead) is very similar to the humphead parrotfish, the Scaridae which was identified as *angol* from a picture. Both of these *angol*, the wrasse and the parrotfish, are perceptually striking or salient due to their large size and bulbous foreheads (see Figures 5 and 6); hence may function as a prototype, prototypicality in this case resulting from perceptual salience (Berlin 1992; Bulmer 1979). Those for whom *angol* is a wrasse might then include some other wrasses in the *linhawan* category, while those who label the humphead parrotfish as *angol* probably include only the other parrotfish in the *linhawan* category. One informant who classified wrasses with parrotfish identified the Napoleon wrasse as *taruungan*, a fish described as having a bulging forehead, which could reach the size of an automobile. An informant who refused to classify the wrasses with parrotfish identified *taruungan* as a type of *mulmol*; thus a parrotfish. This provides further support for the claim that this perceptually salient feature of a bulging forehead contributes to the 'fuzzy' nature (Oden 1977) of the semantic boundary between the wrasses and parrotfish in the folk taxonomy of Atulayan. An attempt to diagram these relationships can be found in Figures 7 and 8.

A term (*bulgan*) which was not identified by most Atulayan informants as a type of *baraka'* illustrates another type of intracultural variability. Most informants said that *bulgan* (identified by Dioneda et al. [1995] as *Cromileptes*

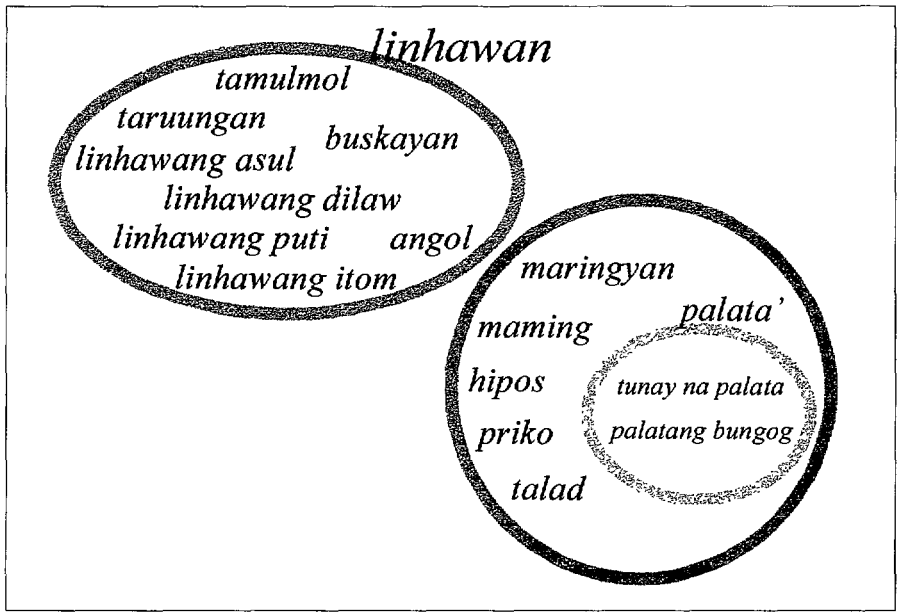

Figure 7. Folk taxonomic structure for *linhawan* not including wrasses in the category.

Figure 8. Folk taxonomic structure for *linhawan* including wrasses in the category.

altivelis, the hump-backed rock cod) is not a *baraka'* but that it looks like *amidon*, which is a *baraka'*. These same informants identify a picture of *C. altivelis* as *amidon*. A few informants said that *bulgan* is the same as *amidon* and identify the picture of *C. altivelis* as *bulgan*. However, there is another fish (Centropomidae, *Lates calcarifer*, the giant perch) labeled with a similar term, *bolgan*. The hump-backed rock cod and the giant perch are vaguely similar in appearance, as noted by North Queenslanders who refer to the former as Barramundi cod "...because the head is somewhat similar in shape to that of the giant perch (erroneously called Barramundi)" (Marshall 1965:159). To further confound this variability in the taxonomy, there appears to be some linguistic variability with respect to the mid- and lower-back phonemes /o/ and /u/ in the vicinity of Sagnay; hence for some, *bulgan* may actually be *bolgan*.

It is interesting to note that another taxon that manifests intracultural variability is *sira'* ('fish'). Some fishers include squid (*pusit*), cuttlefish (*kulambutan*) and octopus (*pugita*) in the category *sira'*, noting that an organism is a *sira'* as long as it swims around in the water. Some even include the sea turtle. Others exclude the invertebrates and turtles. All exclude the sea cucumbers (*balat*). *Sira'* is at the rank of life form in Berlin's (1992) terminology for folk taxonomies, and he notes that there is usually a great deal of intracultural variation with respect to folk definitions for this rank. For example, in American English folk taxonomy there is individual variation with respect to whether an octopus is a fish or not.

Other, equally interesting segments of the folk taxonomy of the fishers of Atulayan Bay can be constructed from the information provided in the taxonomy presented in Appendix I of this chapter. The brief summary presented above should be sufficient to indicate the extent of knowledge possessed by these fishers. Equally important is the observation that there is intracultural variation in this knowledge. If it is true, as some have argued, that ecological knowledge of users is a factor influencing receptivity to and providing information significant for governance (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Johannes 1981), then it is important to understand the distribution of this knowledge. Quantitative investigations of this type of information are time consuming and difficult to analyze–they do not fit the tight time constraints of 'rapid appraisal.' Nevertheless, only quantitative analysis can discern patterns in variation in terms of their distribution throughout the society. Since we argue here that traditional knowledge influences behavior with respect to natural resources, intracultural variations in this knowledge may be related to variance in the way individuals treat these resources; hence, we need to account for this variation for effective governance.

Perceptions of trends in resource availability. Fishers' perceptions of trends in resource availability and factors influencing these trends are important aspects of their knowledge of the coral reef ecosystem. These perceptions are also related to aspects of governance. In a review of a number of case studies, Pinkerton (1989b) found that a perceived crisis in stock depletion on the part of fishers facilitates management efforts. Further, Zerner (1994) points out how incompatibilities between fisher and management entity beliefs concerning factors influencing resource abundance can negatively influence management efforts. In our attempts to understand user perceptions of trends in resource availability over the past five years and factors influencing these trends we conducted in-depth interviews with 10 users (seven fishers and three fish buyers).

Five of the seven fishers and two of the three fish buyers said that catches have decreased. Two of the fishers said catches remained the same, and one fish buyer did not have an opinion. Most frequently mentioned causes of decreased catches were use of illegal methods (e.g., blast fishing and poisons) and commercial gears (e.g., *kitang, kalansisi, pangulong* and *buli buli*). Two mentioned the increase in numbers of fishers. Inadequate enforcement, use of specific gears (e.g., gill nets on the corals), and 'less friendly' or 'smarter' fish were mentioned by others as factors decreasing the catch. Overall, there is a perception of decreasing catches.

GOVERNANCE

The ecology of the coral reefs of Atulayan Bay is potentially influenced by national, regional and local acts, ordinances and/or other official regulatory measures. These measures, institutions created to implement the measures and local response to governance are briefly summarized in this section.

National governance. The Philippine Constitution of 1987 clearly implies that the ownership of natural resources (which includes living aquatic resources) is vested in the state (Section 2, Article 12); and Section 7, Article 13 states that local communities receive preference in exploitation of communal marine and fishing resources (PMO 1994). The Fisheries Act of 1975 (Presidential Decree (PD) 704) and subsequent PDs, Letters of Instructions (LOIs) and Fisheries Administrative Orders largely govern the management of fisheries, emphasizing both conservation and development. These measures were adequately summarized (PMO 1994:69) as follows:

PD 704 considers the following activities illegal: (1) the use

> *of nets with mesh sizes less than 3 cm when stretched, (2) fishing with explosives or poisons, and (3) possession of explosives or poisons by fishers. It also prohibits commercial trawling (>3 gross tons) in waters of 7 fathoms deep or less. Later PDs and Letters of Instructions (LOIs) banned commercial trawls and purse seines within 7 km of the coastline in specific areas or set the procedures for establishing such localized bans. LOI 1328 of 1983 extended the ban on commercial trawls and purse seines within 7 km of the coastline in all provinces. The restrictions on the area where trawlers may operate, as stated in PD 704 and LOI 1328, are often combined and referred to as the 7 km/7 fathom ban. LOI 1328 and Fisheries Administration Order (FAO) 164 set boundaries within which commercial trawls and purse seine and* buli buli *should not operate.*

Regarding coral reefs, specifically, the gathering of ordinary corals as well as the export of precious and semi-precious corals is prohibited by PD 1291 (Coral Resources Development and Conservation Decree) as amended by PD 1698. Certain coral reef resources, such as the mollusks *Charonia* and *Casis*, are also protected (Fisheries Administrative Order 158, 1986 series). There are also laws which sanction the establishment of marine parks or reserves to protect coral reefs (PMO 1994).

National legislation impacting local governance. While these national laws still impact use of living aquatic resources, the Local Government Code (LGC) of 1991 (Republic Act 7160) places the management of municipal waters under the jurisdiction of municipal governments. Sections from the LGC which apply to governance of aspects of the ecology of the coral reefs of Atulayan Bay, as quoted in Roldan and Sievert (1993:31-34), are described below.

The definition of municipal waters (LGC, Section 131) is basic to understanding geographic scope of local governance:

> *Municipal waters includes not only streams, lakes, and tidal waters within the municipality, not being subject of private ownership and not comprised within the national parks, public forest, timberlands, forest reserves or fishery reserves, but also marine waters included between two lines drawn perpendicularly to the general coastline from points where*

> *the boundary lines of the municipality or city touch the sea at low tide and a third line parallel with the general coastline and 15 kilometers from it. Where two (2) municipalities are so situated on the opposite shores that there is less than 15 kilometers of marine waters between them, the third line shall be equally distant from opposite shores of the respective municipalities (*as presented in Roldan and Sievert 1993:31-32*).*

Regarding this territory, the LGC states that "local government units shall share with the national government the responsibility in the management and maintenance of ecological balance within their territorial jurisdiction..." (Section 3, as presented in Roldan and Sievert 1993:32) and the "...enforcement of fishery laws in municipal waters including the conservation of mangroves" (Section 17, as presented in Roldan and Sievert 1993:33). Hence the municipal governments are expected to both enact and enforce necessary living aquatic resource ordinances and other regulatory measures. The LGC encourages the grouping of local government units as well as cooperation with peoples' organizations and NGOs to achieve these ends.

Local governance in Atulayan Bay. The LGC has resulted in several locally developed municipal ordinances with potential impacts on the ecology of the coral reefs of Atulayan Bay. The first, Sagnay Municipal Ordinance No. 93-001 (1993), "Atulayan Bay Fish Sanctuary and Reserve," establishes a marine sanctuary (70.36 ha) and reserve (72.28 ha) in concentric rings around Atulayan Island. A plot of the coordinates contained in the ordinance indicates that the sanctuary encircles Atulayan Island, and the reserve encircles the sanctuary. A staff member in the Municipal Agriculture Office indicated that the sanctuary extends 150 meters from shore all around the island. The boundary of the sanctuary is indicated by marker buoys which were present in early 1995. According to the coordinates published in the ordinance, the reserve is a narrow band, extending seaward from the sanctuary, encompassing an area of 72.28 ha. This ordinance states (Section 4) that:

> *It shall be unlawful for any person or persons, partnership, association, cooperative and corporation, to conduct any fishing operation/activities or take, destroy or kill any fish and fishery aquatic products within the established Fish Sanctuary, or in any manner disturb or drive away or take therefrom any fish fry or fish eggs. Likewise, it be unlawful*

> *for any person to conduct any fishing operations which are destructive to the coral reef habitat, seagrass or any fish habitat within the marine reserve.*
>
> *It shall also be unlawful for any person or persons to fish or use prohibited fishing methods in the established marine reserve such as; Muro-ami fishing or related methods using weighted scarelines or poles, trawl fishing, spear fishing using scuba equipment, fine mesh nets, all kinds of commercial fishing boats, calansisi, fishing with the use of explosives and poisonous obnoxious substances and all other fishing methods/gears of which with the promulgated of law or ordinance prohibits the use of same.*

The penalty for violation (Section 5) for each offense is a fine of not less than 5,000 Pesos and/or not less than one year imprisonment.

Later in the same year (1993), Sagnay Municipal Ordinances 93-003 and 93-006 were passed. Municipal Ordinance 93-003 called for the color coding and registration of all boats operating in Atulayan Bay from the barangays of Sagnay. All boats are to be assigned a registration number (to be painted on the boat) and painted with the colors assigned to the operator's barangay. The purpose of this ordinance is to facilitate identification for enforcement of regulations. Enforcement authority is granted to Philippine National Police, barangay officials, *Bantay Dagat*[26] members and officers of accredited fishers' organizations. Penalties for an offense are nominal fines and/or jail sentences which increase with each offense. Continued offenses can result in grounding or impounding of offending fishing vessels.

Sagnay Municipal Ordinance 93-006 declares Atulayan Bay as a permanent traditional fishing ground, "...a fishing water area wherein only traditional, non-depletive and non-destructive fishing gears and fishing vessels are allowed." The water area of Atulayan Bay is defined in the ordinance as enclosed on the east by a line from the outermost point of Sitio Garang, Patitinan out to point 27 (a geographic coordinate in Ordinance 93-001) of the marine reserve around Atulayan Island, on the south by the coastlines of Patitinan and Bungalon, on the west by the coastline of Sibaguan and Turague, up to Lago Point, and on the north by a straight line from Lago Point to point 23 on the reserve area encircling Atulayan Island. The ordinance states the following:

> *For purposes of this Ordinance, the operator of Kalansisi,*

trawl, Purse seine, Basnig, and other related non-traditional fishing boats are prohibited in "Atulayan Bay".

It shall also be unlawful at all times for any person, association, corporation, partnership and cooperative to conduct fishing operation in the aforementioned water area with the use of the following methods and fishing gears:

a. Dynamite fishing and other explosives
b. Muro-ami fishing and other related methods using weighted scare lines and poles
c. Spear fishing using scuba/compressor
d. Cyanide fishing and other poisonous substance
e. Very small meshed gill nets (less than 5 cm)
f. Sinsuro and
g. Other fishing methods and fishing gears which are depletive to fish stocks and destructive to coral reef habitat within the aforementioned water area.

The ordinance also restates the requirement for color coding of vessels described above. As for enforcement "The Sagnay Philippine National Police, Paramilitary forces, Barangay Officials of the coastal area, *Barangay Tanod*, The *Bantay Dagat*, Official and members of accredited fishers association and other accredited NGOs are hereby deputized to effectively enforce this ordinance" (Section 7). Penalties for violation are a fine between 1,000 and 5,000 Pesos and/or imprisonment between one and six months.

Finally, Article Five of the Municipal Tax Ordinance (No. 92-001), published in December 1994, regulates fishing and/or fishery privileges. Section 167 requires a municipal license permit for all types of legal fishing and municipal grants for operating fish corrals, oyster or mussel culture beds, or taking of bangus, prawn, or any type of fry for propagation within the municipality. Other sections of the law set forth zones for grants for aquaculture and fish corral operations or fry collection, fees for aquaculture operation use rights, limits on sizes (allowable area) and spacing of aquaculture and fish corral operations, and license fees for all other fishing operations.

Exclusive fishing privileges (restricted to grants for aquaculture beds, fish fry collecting areas and fish corrals) are applied for by sealed bid, with two years rent bonded by cash, property in the Philippines, or a surety company authorized for that purpose. All who have obtained fishery privileges (license or grant) within the municipal waters are required to report (in triplicate)

monthly reports of quantity, kind and value (if sold) of fish caught during the month.

Hence, there are laws governing allowable gears and methods, areas closed to capture fishing (sanctuaries) as well as fry collection, fish corrals, and aquaculture operations, reporting requirements and fees for usage (license permits and grants). Fishers reported no traditional practices that could be construed as governance. The only evidence of territoriality, outside municipal licensing requirements, were reports that fishers from other municipalities must request permission from the municipality prior to fishing in municipal waters. That, however, is apparently covered by the license code. One barangay captain reported that permits were required to fish in her waters, but the rule was frequently broken with no means for enforcement. The required color coding and numbering of boats, however, will make any territoriality easier to enforce.

Institutions impacting local governance. In the larger context, the Fishery Sector Program (FSP)[27], in line with the LGC's encouragement of the grouping of local government units as well as cooperation with peoples' organizations and NGOs to achieve resource management, developed a program of resource and ecological assessment and coastal resource management for Lagonoy Gulf, one of FSP's 12 priority coastal areas in the country. International Center for Living Aquatic Resources Management (ICLARM), together with the Bicol University College of Fisheries, conducted the resource and ecological assessment (Silvestre et al. 1995). Coastal resource management in Lagonoy Gulf involved two NGOs in community organization: an NGO called Development Research and Resource Productivity (DRRP) for Camarines Sur, and the Philippine Rural Reconstruction Movement (PRRM) for Albay and Catanduanes.

The Lagonoy Gulf Resource and Ecological Assessment Project's objectives were carried out in five components. Component 1 (Training) was designed to strengthen the Bicol University College of Fisheries' capabilities in coastal resource management (e.g., training in fish stock assessment and habitat assessment). Component 2 (Situational Analysis) produced a summary and analysis of the status and utilization of Lagonoy Gulf's fisheries and related coastal resources and habitats, including stresses, impacts and preliminary management implications. Component 3 (Capture Fisheries Assessment) provided a biotechnological assessment of fishery resources as well as suggestions concerning sustainable yields. Component 4 (Habitat Assessment) focused on elements of the gulf's biophysical environment related to fishery production and sustainability. Component 5 (Integration of Results and Formulation and Assessment of Resource Management Options) synthesized

results of project activities and developed resource management options for Lagonoy Gulf (Silvestre et al. 1995). A database was prepared by the project to facilitate this process (Garcia and Alojado 1995).

Component 5 assisted in the formation of an Interim Organizational Group (IOG) that took charge of organizing the Lagonoy Gulf Resource Management Council (LGRMC). The IOG later created an Interim Planning Committee (IPC) that was given the task to formulate a management plan for the gulf. Component 5 guided the IPC in structuring the planning process. Six recommendations evaluated and prioritized by the IPC were: 1) closing the gulf to commercial fishing; 2) law enforcement campaign against destructive fishing; 3) closed season to protect the Siganidae fishery; 4) establishment and management of marine sanctuaries; 5) mangrove reforestation; and 6) watershed reforestation. According to Lua et al. (1995) having these main building blocks for a management plan, the IPC will only need to deal with packaging. The LGRMC will have the final say on the plan and its implementation.

The LGRMC is composed of representatives from the regional government line agencies for fisheries and for environmental management, local government units, NGOs, municipal and commercial fishing sectors, the Philippine National Police (PNP) Maritime Command and the private/ industrial sector from the three provinces bordering the gulf. It was created under the FSP as a central body that will coordinate all efforts towards the unified management of the gulf's coastal resources. It is composed of the executive committee and the following working committees: 1) legal and technical; 2) law enforcement; 3) finance; 4) information and education; and 5) plans and programs. It was formally launched in October 1994.

Use of NGOs to facilitate community organization and income diversification has been suggested as a strategy to ensure success of coastal resources management (Roldan and Sievert 1993). This process was followed as a part of implementation of the FSP in Lagonoy Gulf. DRRP and PRRM assisted in forming fishers' organizations and strengthening existing fishers' organizations in selected coastal barangays of Lagonoy Gulf. PRRM was reported to have participated in organizing *Bantay Dagat* units for Albay and Catanduanes by recommending members of fishers' organizations to the Provincial Fisheries Management Units of the two provinces. In 1994 PRRM reported that 110 individuals from 28 barangays had joined *Bantay Dagat* under the FSP, and that they were in the process of federating all 28 units (Gorospe 1994). DRRP's community organizing activities resulted in drafting local level coastal resource conservation and management resolutions by barangay community leaders which were submitted to their respective municipalities for approval (DRRP 1993).

A coastal resources management meeting involving community leaders from Camarines Sur in June 1993 resulted in the formation of an ad hoc committee composed of representatives from different barangays. This committee is seen as a first step in formalizing an inter-barangay bay management organization which is expected to coordinate and otherwise assist communit- initiated coastal management efforts (DRRP 1993). It is also reported that barangay and municipal resource management councils have been established under the FSP (Gorospe 1994).

Fisher compliance with governance. One measure of a system of governance's success is degree of fisher compliance. Initial interviews with a few local authorities suggested that fishers were complying with regulations and the few violations that occur were being prosecuted.[28] As more time was spent in the area, interviewing a wider range of individuals and actively observing fishing activities from both shoreside and boat, a different picture of the degree of compliance emerged. Fishing activities, although restricted, continue in the marine sanctuary that surrounds Atulayan Island. The types of gear used are handline (*banwit*), spear gun (*pana*), gill net (*panke*) and two types of fine meshed nets called *sarap* and *kuralon*. These violations occur openly, frequently along the beach fronting the residences in the barangay, in full view of residents and resident officials (e.g., the barangay captain).

The use of prohibited gear types and illegal fishing methods in Atulayan Bay, although declared by ordinance a permanent traditional fishing ground, is also widespread. Commercial ring nets (*kalansisi*-local informants frequently refer to this gear as *palakaya*[29]) still frequent the area, and one was observed setting a net in the bay during the research period in early 1995. According to local fishers and other informants, the most frequent unwelcome visitors in Atulayan Bay are these commercial ring net fishers, coming from the nearby provinces of Albay and Quezon, and from Pasacao in Camarines Sur. A barangay captain said that this was the biggest problem in the bay as far as violations were concerned. *Kalansisi* from Nato and some of the coastal barangays of Sagnay were also reported to frequent the area. The chairperson of *Oplan Sagip Dagat*,[30] a composite team in charge of implementing law enforcement activities in Atulayan Bay, said that they apprehended a five-man crew from Nato using modernized gear. As their first recorded offense, the violators were advised and later released. They were warned that a second offense would mean a penalty and the submission of their names to the authorities.

Other types of prohibited *palakaya* reported to operate in the bay are *pangulong* (purse seine) and *buli-buli*, the operators of which are reported to come from the Visayas. The *pangulong* is similar to the *kalansisi* in its

operation but the former uses longer nets in deeper parts of the bay. The *buli-buli* employs 10 divers using a scare line composed of a nylon cord and strips of plastic straw bunched together at the end of the line to drive the fish from the corals into a nearby net.

Illegal fishing practices such as the use of explosives (*bomba*) and poisonous substances (*hilo*) also have not ceased. Dynamite fishing, however, has been somewhat minimized. According to the *Oplan Sagip Dagat* chairperson, ammonium nitrate (the powder for making explosives used in dynamite fishing) comes from Barangay San Roque (in Tabaco, Albay) and is sold in the coastal barangays of Sagnay at 50 Pesos per bottle. The same source also disclosed in an interview conducted in 1994 that ammonium nitrate was discovered to be smuggled into Bicol. Some of the powder that is bound for a mining corporation in Marinduque (an island province west of Camarines Sur) where it is used in mine blasting, was said to be left in Lucena and taken to Bicol for dynamite fishing purposes. Also, suppliers evade the inquiries of authorities by allegedly claiming that the powder will be used as fertilizer for agricultural crops and as flower inducer for mango trees.

The use of dynamite in Atulayan Bay has been attributed to fishers from Albay, neighboring municipalities, and some fishers from the Sagnay Barangays Bungalon and Turague. Operations were reported to be as frequent as four times a week during the past year. The barangay captain of Patitinan reported these incidents to the municipal authorities, but they allegedly took no action to stop the violations. A Patitinan fish trader added that there were two incidents when dynamite fishers were turned over to the municipal authorities by the barangay *tanod* (or barangay brigade). However, the violators were only warned and later released, which disheartened the barangay *tanod*. A case was filed against a Nato dynamite fisher after authorities (who were tipped by some fishers) raided his residence and found dynamite paraphernalia. A recent apprehension of a dynamite fisher from Bungalon by the Citizens' Armed Forces Geographical Unit (CAFGU) led nowhere when municipal authorities found out that the CAFGU people failed to follow standard apprehension procedures. Instead of only taking a sample of the catch, they confiscated the entire catch to be used as evidence. In which case, making it possible to claim that false evidence was planted against the violator while the catch was 'in transit.' As a result, the fisher was later released.

Albay fishers are reportedly using sodium cyanide together with a compressor to catch aquarium fish. In fact, a well-known Nato fisher who owns a compressor was identified by many informants. Another fishing method reportedly employed in the bay uses sodium cyanide but without the compressor. Instead, anchovies (*bulinao*) are diced, immersed in a pail containing the poison and strewn on the surface of the water for the fish to

feed on. As soon as the poison takes effect, fish are scooped out of the water with a scoop net (*silo'*).

Other gears prohibited by the local ordinance cited above, but are still operating in the traditional fishing grounds of Atulayan Bay are the beach seine (*sinsoro*) and bag net (*basnig*).[31] Fishers from Bungalon reportedly use *sinsoro* in the declared traditional fishing grounds. A *sinsoro* was also observed being deployed off the waters of Turague. Additionally a Patitinan fish trader reported that fishers from Sibaguan operate *sinsoro* in the area in front of his barangay. The barangay captain of Patitinan added that *sarap* fishers continued operating in the waters in front of the barangay despite warnings made by the barangay *tanod*. We even observed the use of *sarap* in the sanctuary surrounding Atulayan Island.

CONCLUSIONS

Fishing is clearly an important aspect of the human ecology of Atulayan Bay: some one-fifth of the households in the coastal barangays derive all or most of their income from fishing, and a significant proportion of animal protein consumed in these barangays is derived from the bay's waters. For the most part the fishing is small scale, conducted from relatively small (three to six meter), double outrigger boats, less than half powered by 12 to 16 horsepower inboard engines. Gleaning of shellfish adds variety to the diet and contributes much of the animal protein during slack fishing periods. A significant, but not major proportion of the aquatic organisms fished and gleaned reportedly come from the corals. Some times of the year, coral fish are the only types available for subsistence, and it is hard to say how much the non-coral fish depend on the productivity of the coral reefs for sustaining their population levels. At present, it is probably safe to conclude that practically all aquatic organisms captured by the fishers of Atulayan Bay are consumed locally. An international market for locally caught sea cucumbers is apparently in decline. Hence, the coral reefs of Atulayan Bay contribute significantly to the livelihood and nutrition of the local population.

The fishers of Atulayan Bay know a great deal about the aquatic organisms living in the bay. They have a highly structured taxonomy of these fish, including hundreds of local names–a clear indication of their detailed observations. They also know enough about the habits of these hundreds of species to target and capture them effectively; hence, earning an income and feeding their families. For the most part, they also know that the amount of fish they are catching has been decreasing in recent years, and they blame these decreases on the use of illegal methods (e.g., blast fishing and poisons) and commercial fishing gears. Increases in numbers of fishers, inadequate

enforcement, and 'smarter' or 'less friendly' fish were also mentioned as causal factors. Overfishing and destructive fishing methods are widely recognized as serious problems in the Philippines, and both local and national laws have been and are being enacted to deal with these issues.

Aware of the need to conserve the coral reefs and other aquatic organisms of Atulayan Bay, the municipality of Sagnay enacted the ordinances described in previous sections of this chapter–ordinances directed at establishing a sanctuary and reserve, ordinances repeating the bans on destructive fishing methods already in national laws and ordinances directed at keeping commercial fishing methods out of Atulayan Bay. Reportedly, the ordinances were presented to public meetings of fishers before approval and they are being obeyed. The latter report, however, does not match observed reality. Destructive fishing methods are still employed, commercial gears are observed fishing in the bay and fishers openly fish in the sanctuary. This observed reality, however, can be interpreted as reflecting several distinct problems–problems which could be disastrous in terms of the future of coastal and fishery management in Atulayan Bay.

The first problem involves enacting laws without means of surveillance or enforcement. Research suggests that certainty of apprehension and punishment has a strong impact on behavior (Paternoster et al. 1984), and the lack of adequate personnel or equipment for enforcement reduces the probability of being apprehended to almost zero. Hence, the law breakers catch a lot of fish while law abiding fishers have to be content with less–a situation conducive to institutionalized evasion of rules, especially in an area where most families have incomes below the established poverty level.

The next problem involves peer opinion–whether or not the fishers believe that significant others will disapprove of one's illegal behavior. This internalization of what is perceived as a societal norm that laws should be obeyed is an important factor influencing voluntary compliance (Hoffman 1977), and voluntary compliance is essential in a situation of inadequate surveillance and enforcement. Since it is reported that most fishers employing destructive methods and illegally deploying commercial gears are outsiders, from other areas, disapproval by Atulayan fishers probably has little impact on their behavior. If they have internalized a societal norm that laws should be obeyed, perhaps this applies only to laws in their home community. Additionally, it might be inaccurately reported that most violators are outsiders because Atulayan fishers do not want to admit that local fishers would be such scofflaws.

Violation of the sanctuary reflects another, perhaps more significant problem. As described above, local fishers were observed openly violating the sanctuary around Atulayan Island. Fishers also admitted fishing in the

sanctuary, saying it was the only place they could fish and that they have always fished there. These admissions and open violations suggest there is little or no peer disapproval for these violations in contrast to the forceful complaints and disapproval concerning the use of destructive and commercial fishing techniques in Atulayan Bay. With little or no peer disapproval, there is little hope for voluntary compliance, especially when the fish captured are perceived by community members as essential to the existence of the fisher's family. Further, in a study examining the correlates of compliance in a Malaysian fishery, Viswanathan (1994) reports that fishers are likely to violate a regulation when they believe that a large proportion of fishers violate the regulation. This could have the effect of spreading the violations beyond needy fishers.

The next question we have to ask is why is there little or no peer disapproval of breaking some of the fishery rules? Perhaps there is little or no support for the specific law or the law makers–what some researchers refer to as legitimacy (Tyler 1990), which is frequently related to perceived fairness of the law. In terms of fairness, Viswanathan's (1994) research indicates that Malay fishers are concerned with the distributive justice of a regulation. Concern with distributive justice might be the factor that motivates lack of concern with respect to needy fishers fishing the waters of the sanctuary. Further, perceived fairness is related to participation in the decisionmaking process that results in the law (Tyler 1990). The fishers were reportedly involved in procedures leading to the sanctuary ordinance (e.g., attendance at a meeting), but percent attendance and type of involvement is unknown. Perhaps it was not sufficient to result in a perception of fairness.

Whatever the factors influencing noncompliance, it is a fact, and it occurs frequently. Scofflaw behavior frequently becomes institutionalized–e.g., a part of expected behavior. As Viswanathan (1994:139) notes, "...if many fishermen are getting away from detection and arrest, the overall compliance rate for a given population will decline and thus threaten the success of the regulatory program." The institutionalized evasion of fishery and coastal management regulations, regulations which are notoriously difficult to monitor and enforce under the best of conditions, can have disastrous future effects on the coral reefs and fishery of Atulayan Bay. Future regulations, no matter how well designed, may be disobeyed by a community with a norm of scoffing at a plethora of unenforced laws. Perhaps it is better to produce no regulations until compliance can be assured through adequate surveillance and enforcement as well as appropriate local involvement to enhance legitimacy. Careful attention at this stage in the development of the coastal zone and fishery management process can help maintain and possible improve the human ecology of the coral reefs of Atulayan Bay.

NOTES

1. Not all barangay officials were able to provide figures concerning number of fishers or fisher households. For Sagnay as a whole the Garces et al. (1995) figures were the most current, and methods described were adequate. In the brief descriptions of individual barangays, numbers will be provided in terms of number of fishing households. In some cases, estimates will be made based on reported number of fishing vessels (see note 2, below).

2. These figures are from a survey conducted in late 1994 by the Office of the Municipal Agriculture Officer. The survey listed all boat owners by name and was directed at providing these names for the mandatory registration and painting of all fishing vessels in Sagnay. There are differences between these figures, the PRIMEX (1993) figures, those provided by barangay officials (February 1995 interviews), and those provided by the individual responsible for registration and painting of the vessels (February 1995). Figures from the 1994 survey are used for several reasons: 1) some barangay captains could not provide these figures; 2) the figures from the individual responsible for registration were incomplete and he reported them from memory; and 3) the PRIMEX (1993) figures, by barangay, differed a great deal from 1995 interviews and observations. The best method for determining number of boats is to count them at a time when most, if not all, are at the dock, on the beach, etc. Most of the coastal barangays had several beaching and/or docking areas spread over a rugged coastline, making such a procedure impractical, given the time constraints of the project. The only barangay (Atulayan) where this was accomplished resulted in a vessel count of 78 at two p.m., when it was reported that all boats should be beached. It is realized that some boats may have been taking fish to market, obtaining water from the mainland, or conducting some other task. Nevertheless, the count of 78 is extremely close to the Office of the Municipal Agriculture Officer's count of 74. The Office of the Municipal Agriculture Officer list of vessel owners was checked by an Atulayan resident who added a few names and was unsure concerning about one-fourth of the list (but could not discount ownership), resulting in a figure of 79 vessels. The closeness of this confirmation, as well as the detail in the data (a list of names of owners!), led us to select the Office of the Municipal Agriculture Officer survey as the best available information.

3. This survey was part of a larger survey of all the coastal barangays in Lagonoy Gulf.

4. A *sitio* is a section of a barangay. It has no administrative power.

5. Differences between various supposedly 'knowledgeable sources' was so great in the case of Sibaguan, that it provides a prime example of the need to cross-check information. More conflicting information was obtained in the municipal center just prior to our departure from the area, and it was impractical to return to Sibaguan to make a vessel count, especially since *sitios* with fish landings were isolated along the coast and fishing times varied.

The figures speak for themselves: PRIMEX (1993)–three motorized, four non-motorized boats; Office of Municipal Agriculture Officer survey (see Note 2)–49 boats; ex-barangay captain who is an active fisher, living among the fishers–50 unmotorized, 3 motorized boats; barangay secretary–150 non-motorized and 10 motorized boats; individual responsible for vessel registration and painting, 84 non-motorized and one motorized (see Note 2). The barangay secretary presented some questionable information on household occupations and simply subtracted the number of farming households from total number and assigned the remainder to fishers. His boat numbers were probably influenced by that number and are grossly out of line with the other figures (and observations). Hence, number of fisher households will be estimated from number of boats and identified as a questionable estimate.

6. A woman and a man were observed deploying a gill net at the mouth of the Sagnay River, and it was reported that wives sometimes accompany their husbands on fishing trips.

7. The best information can be obtained from landing and marketing statistics, but they are rarely available. They were not available for Atulayan Bay. There is also a potential problem with market surveys and/or marketing statistics. Where the focus is fishers impacting a specific coral reef area, it will be difficult, if not impossible in some cases, to identify fish in the market with fishing area.

Use of key informants for obtaining information concerning importance of species can be complicated by several factors. First, if the ranking is to be accomplished in terms of economic significance, middlemen and/or retailers are probably a good source of information. Once again, however, it is important to determine if the middlemen or retailers are aware of the fishing areas used by the fishers. Primary buyers (those who buy fish directly from the fishers) probably know where the fishers fish, but the investigator must check to make sure. Stevenson, et al. (1982) describe a system for recording data by primary buyers which could be adapted to include fishing area. This, however, is not

a 'rapid assessment' technique. Its establishment, however, could lead to more accurate data.

Use of fishers to obtain information concerning economic importance is complicated by the fact that different gears target different species; hence, fishers would have to be representative of the different gear types used in the local area. When the ranking is to be done concerning home consumption, it is only the fishers who can serve as key informants, and the same differences by gear apply. Fishers also find it difficult to answer a question concerning a comparison between two major classes of fish (e.g., coral reef fish versus others) with regard to income and home consumption if there is a seasonality with respect to the classes. We found that we had to have the fishers compare the classes within each season and then ask for a comparison of seasons.

8. Fish are listed by order of importance; e.g., the first in the list being the most important, etc. Order of importance was determined using two criteria: 1) number of informants mentioning the fish in their list of important fish and 2) rank order in the informant's list. If more than one type was mentioned by the same number of informants, mean rank order was used to order the fish in the final list presented here. It must be noted that relative salience of different species probably varies according to season, and relative salience is probably related to whether or not a given type is included in the list as well as rank order in the list; hence, the measure is not perfect, but it is better than nothing and reflects time, manpower, and available information constraints. Most important, methods for determining the ranking have been presented, along with evaluation, permitting the user to determine usability.

9. Also referred to as *dilis*, the Tagalog term for anchovy.

10. Frequently referred to as *galunggong*, the Tagalog term for scad.

11. The juvenile form of this species (*abubngon*) was also listed and counted in the calculation of relative rank.

12. Details concerning taxonomic relationships such as these will be provided in the folk taxonomy section of the chapter.

13. Also referred to as *buraw-buraw*, which is similar to the Visayan term for the same species (*bulao-bulao*).

14. Dioneda et al. (1995) list four other crevalle as *salaysalay* or *salay-salay*.

15. Also referred to as *surahan* in Bicol. *Mungit* is a Visayan term, but several informants used the term to refer to the unicorn fish.

16. Some informants said that *bokawon* is a juvenile *dugso'* (*Lethrinella miniatus*). In Catanduanes, *bukawon* is used to refer to most emperor fish (*Lethrinus sp.*).

17. We did, however, observe one fisher who was distressed by the prices paid by his buyer.

18. More detailed semantic analysis would probably uncover the fact that these terms are not equivalent. They may refer to different configurations of coral or be derived from different local languages. Unfortunately, time did not permit us to spend more time of this topic.

19. A good example of this species diversity for the Philippines is provided by McManus et al. (1992) who list some 545 species for the Bolinao area. For Lagonoy Gulf, Dioneda et al. (1995) list over 450 fish species.

20. In folk taxonomies, shark would be at what Berlin et al. (1973) refer to as the generic level. Evidence suggests that this level is learned first by children (Berlin et al. 1973; Stross 1973).

21. Berlin's (1992) extensive comparative work has indicated that most folk taxonomies manifest five (very rarely six) ranks. Continuing with the folk, American English shark example these ranks are: 1) kingdom (animal); 2) life form (fish); 3) intermediate (no term); 4) generic (shark); 5) specific (hammerhead shark); and 6) varietal (no term).

22. In Western scientific biology, Serranidae is at the rank of family (actually a large family which is divided into several subfamilies). We, however, have assigned *baraka'* to the folk generic rank since in the folk taxonomy of the fishers of Atulayan Bay it falls immediately under the folk life form *sira'* (fish) and includes, immediately under it, taxa at the folk specific (and Western scientific specific) rank. This finding supports Berlin who writes that "for...smaller vertebrates, and many invertebrates, the correspondence of folk generic taxa more closely approximates the scientific taxa of the ranks of family, order, or class" (Berlin 1992:26).

23. The discussion of *pagi* fits well with Berlin's (1992:29) observation that when the name used to label a prototypical taxon is the same as that used

to label the superordinate taxon it will be modified with a term such as "...'genuine,' 'real,' or 'ideal-type'" when it needs to be distinguished from other congeneric taxa at the same rank.

24. Berlin (1992) reviews some of the issues involved in variation in ethnobiological knowledge. Few quantitative analyses have been published (Hays 1976; Boster 1986; Berlin 1992), probably due to the difficulties involved, not the least of which is the amount of time it would take to collect and analyze folk taxonomies from a sample of individuals. Research conducted by Pollnac (1974, 1975a, 1975b) provide examples of the complexity of the type of analysis necessary to quantitatively account for intracultural variation in conceptual systems. Nevertheless, only quantitative analysis can discern patterns in variation in terms of distribution. Since we argue here that traditional knowledge influences behavior with respect to natural resources, intracultural variations in this knowledge may be related to variance in the way individuals treat these resources.

25. These folk specific secondary names can also be produced with the modifier before the folk generic terms. For example *linhawang puti'* and *puting linhawan* are interchangeable.

26. *Bantay Dagat* or 'guard sea' refers to local fishers given the task of policing the sea.

27. The Fishery Sector Program

28. Reports concerning compliance frequently vary depending on the informant. Local officials usually want outsiders to believe that their regulations are effective. Representatives of fishers' organizations want people to think that the fishers always follow the law, etc. Where enforcement is lacking due to inadequate personnel or equipment, official records can be of little value. In these cases, only interviews with fishers whose trust has been gained or direct observation (best, but not always practical) can provide reliable information.

29. The Bicol term *palakaya* means 'fishing gear.' However, for some reason, it has been used as a term for gear types that employ 'modernized' boats. In our interviews in Sagnay, informants used the term to refer to commercial gears. Since the *kalansisi* is the most frequent type that operates in the bay on a commercial scale, it became synonymous to the term *palakaya*.

30. Tagalog for 'plan to save the sea.'

31. While the ordinances seem clear regarding the prohibition of these gears from the declared traditional fishing grounds of Atulayan Bay, some knowledgeable key informants seem to disagree. One, who has a position in the Lagonoy Gulf Resource Management Council, said that a municipal ring net is considered traditional provided the mesh size of the net used is three cm or bigger. For bag nets, he said that there is a closed season in the bay from April to May, during the spawning of scad species. This person is a boat owner, and it appears that the types of pressures applied by vested interests in management councils in other parts of the world are being applied in Lagonoy Gulf.

APPENDIX I TO CHAPTER 3

FOLK TAXONOMY
sira' [fish]

abu-abuhan Haemulidae *Plectorhynchus Chaetodontoides* [type of **alatan**, all grey with spots]

abubngon Carangidae *Scomberoides boops* and *S. crumenophthalmus* [juvenile **atuloy** and **matangbaka**]

abuhon Serranidae *Epinephelus summana* {R}[type of **ugapo** which is a type of **baraka'**]

agbaon Lethrinidae? [**bukhawon/dugso** type][a]

agingoy Mullidae *Parupeneus indicus, P. multifasciatus* {RB} [type of **timbungan**][a]

agwas Muglidae *L. vaigiensis* {I} [also superordinate term]

alang Serranidae [type of **baraka'** {P} yellow with brown spots]

alatan Haemulidae *Plectorhynchus pictus*, {P}*chaetodontoides, P. goldmann* {I}; {P}*polytaenia* {R} [also superordinate category]

alubaybay Clupeidae [type of **tamban**, similar to **tamban** but grows no larger than finger width and 4" long; not **maripati**— **maripati** is round and **alubaybay** is wide][a] [type of **maripati**; **alubaybay** (adult), **kiskisan** (juvenile)][b]

amangpang Pomacenthridae *Abudefduf sordidus* {R}

amidon Serranidae *Cromileptes altivelis* {R} [type of **baraka'** looks like **bolgan** which is not **baraka'**][c] [identified first as **bolgan**, then "or **amidon**"][a]

amumrok Scorpaenidae *D. zebra* {R}

anduhaw Caesionidae *C. erythrogaster* {R} [type of **roskita**]

angangaldit Acanthuridae *Acanthurus dussumieri* {I}, {R}

angol Scaridae *Bolbometopon muricatum* {R}[type of **linhawan**]

aniban Unidentified {lives in corals}

ariwan Carangidae *C. sexfaciatus* {I} [type of **malagimango**; black spots; also referred to as **tagiptipon**]

arungan Lutjanidae *L. fulviflamma* {R} [type of **bukhawon** which is the same as **dugso**][a] [**bukhawon**'s appearance is similar to **dugso**'s but not the same; **arungan, dugso**, and **bukhawon** have similar forms and are grouped together in the market][b]

atuloy Carangidae *Scomberoides boops* {I} [adult **abubngon**][c] [type of **abubngon**][a,b]

bagaong Theraponidae *T. jarbua; T. puta; T. theraps* {R, I} [croaker caught in fresh water and on the reef][a]

bagong Balistidae *B. fuscus* {R}

bahul-o' Carangidae *C. stellatus* {I} [type of **malagimango**, similar to **tarukugan**]

balanak Muglidae *M. cephalus* {I} [type of **agwas**]

balanakun Shark [type of **pating**]

balnutan Carangidae *C. ciliarius* [type of **malagimango**]

banagun Mobulidae *Aetobatus narinari* {I} [type of **pagi**, spikes on tail, *A. narinari* does not have spikes on tail. Conflict with ICLARM local name?][a]

bangarao Lutjanidae *Lutjanus decussatus* {R, P} [type of **bukhawon** which is the same as **dugso**][a] [**bukhawon**'s appearance is similar to **dugso**'s but not the same; **arungan**, **dugso** and **bukhawon** have similar forms and are grouped together in the market][b]

bangkulis Scombridae *T. albacares* {R} [**bangkulis pure**] [also a superordinate category]

bangkulisan/bangkulison Shark [type of **pating**, head like **bankulis**, but longer body]

bangkungan Carangidae *A. indicus* {R, I}

banglus Chanida *Chanos chanos* ["the mother of bangus" **bangus** is smaller]

banogon Mobulidae [type of **pagi**]

banolog Serranidae *Cephalopholis miniatus* {R, P}[type of **baraka'**][c] and [superordinate term over **banalog** (*Pectropomus leopardus*, {R}) and **kabang** (*P. elanoleucus*)][d]

barao Unidentified [found in deep water, caught with *panke*]

baraka' Serranidae *Epinephelus bleekeri* {R} [also a type of **baraka'**][a] and [superordinate category]

barason Muraenidae *Echidna nebulosa* {R} [type of **labong**]

barera Chirocentridae *C. dorab, C. nudus* {I}

barorog Leiognathidae *L.daura* {I} or *Gazza minuta* and *Leiognathus bindus* {R}[a] [juvenile **sapsap**][b] [type of **sapsap**, **sapsap** and **bororog** belong to the same class, **barorog** is used for both juvenile and adult][a] [**sapsap** is Tagalog and **bororog** is Bikol]

barorong Drepanidae *Drepane longimana* {R} [juvenile term for **takmo**]

barurog Carangidae *C. malabaricus* {I} [type of **sapsap** which would make it Leiognathidae ?][a]

bataway Siganidae *Siganus lineatus, S. spinus* {I} or *S. argenteus* {R}[a,b] [*S.*

argentus is **tunay na bataway** (**bataway** natural) also superordinate category][a,b]

bayang Stromateidae *P. chinensis* {R} or *P. argenteus*

bibliya Unidentified

big-ho' Xiphiidae *Xiphias gladius* {I} or *Makaira nigricans* {M}[a] [short dorsal fin (**layag** in Bikol); also called **olob**][a] [type of **malasugi**]

bigok Xiphiidae *Xiphias gladius* {M} [round, short body; caught at night][a] [type of **malasugi**]

bisugo' Nemipteridae [superordinate category]

bokawon/bukawon Lethrinidae *Lethrinus lentjan* {I} [not L. *lentjan*; form is similar to *L. choerorhynchus* {R}][a,c] [superordinate category, same as **dugso**][a] [**bukhawon**'s appearance is similar to **dugso**'s but not the same; **arungan**, **dugso** and **bukhawon** have similar forms and are grouped together in the market][b]

bolgan Centropomidae *L. calcarifer* {I}

bolinawon Shark [type of **pating**]

botanding Rhincodontidae *R. typus* {I}

brunsihan Unidentified [**kroner** alternate name, golden color, caught around *tabao* using net or *og-og*, from March to November, adult size 5", shape similar to **lison**]

bugiw Hemiramphidae *H. far, H. georgii* [also superordinate] [white and no red mark][a]

buka dulce Polynemidae *Polynemus plebeius* {R}

bulan-bulan Megalopidae *M. cyprinoides* {I}

bulangawan Carangidae *E.bipinnulatus* [also called **salmonon**]

bulao Lethrinidae *Lethrinus sp.* [similar to *L. ornatus* but deeper and rounder body][a] [juvenile **kamasuhon**]

bulaw Serranidae [type of **ugapo'** which is a type of **baraka'**, golden brown]

bulgan Serranidae *Cromileptes altivelis* {R} [same as **amidon**][a] [looks like **amidon** but is not **baraka'**; brown body with grey *batik* and big mouth][d]

bulinau/bulinao Engraulidae *Stolephorus sp.* [superordinate category]

buraw Scombridae [superordinate category]

burawon Scombridae *E. affinis* {I} [see **turingan**]

buring Pomacentridae *Abudefduf vaigiensis* {R}[c] or *A. septemfasciatus* {R}[a,b]

burirawan Scombridae *Rastrelliger brachysoma, R. faughni* {R} [type of **bangkulis**; has round spots on back]

burlis Gerridae [**sulaybagyo** juvenile term; **hagupit** mature; **burlis** applies to skinned adult]

burok Hemiramphidae *Hemiramphus sp.* {R} [red tip of beak and horizontal white stripe across body] [a type of **bugiw**]

buroy Hemiramphidae [a type of **bugiw**]
burubangkulis Scombridae [4 kilogram, lateral line different from **bangkulis**]
burubarahan Haemulidae? [similar to **alatan** in form; has horizontal black/ white line across body and black *batik* (mottled) all over body]
burubaraka Serranidae [kind of **baraka'**]
buskayan Scaridae [type of **linhawan**]
butete Tetraodontidae *A. hispidus* {Rau588}
butong-panday Synodontidae *S. micropectoralis* {R} [type of **tiki'**]
cataway Siganidae *S. argenteus* {I} [type of **bataway**]
daguldulan Leiognathidae *Leiognathus splendens* {I} [type of **sapsap**]
dalagang-bukid Caesionidae [superordinate term for **roskita**, from Tagalog]
dalamugon Mobulidae [a type of **pagi**]
dalupani Leiognathidae *L. equulus* {I} or [looks like Gobiidae *pentaprion longimanus* {R}, grouped with **ramurok** and **sapsap**][b]
dilis Engraulidae [Tagalog term, see **bulinau**]
dugnitan Serranidae *Cephalopholis argus* [type of **baraka'**] [not a type of **baraka'** in Atulayan; could be a term used in Rapu-Rapu, Albay][d]
dugso' Lethrinidae *Lethrinella miniatus* {R} [also see discussion under **arungan** and **bokawon**. Some consider **dugso'** as superordinate term because it is biggest of the group it is supposed to name][a]
durog Serranidae *Plectropomus truncatus* {R}[type of **baraka'**]
duwal Belonidae *S. incisa, T. acus* {R}
galunggong Carangidae *Decapterus sp.* [Tagalog, **sibubog** in Bicol]
guno' Atherinidae *A. forskali, H. woodwardi* {I}
gurayan Clupeidae [type of **maripati**][a,b] [also a type of **timbungan**, a Mullidae][a]
gurayan Mullidae *Parupeneus barberinus* {I}
hagupit Balistidae *Alutera monoceros, Cantherhines pardalis, Monacanthus chinensis* {R} [juvenile called **sulaybagyo**; skin texture like sandpaper]
hagmang Muraenidae *G. punctatofasciatus* {R}
halaban-on Scombridae *R. faughni* (R} [type of **buraw**]
hal-o' Spyraenidae *S.obtusata* {R} [also called **manabang**]
hanapos Carangidae *Seriola dumerili* {P}
hamil-hamil Caesionidae *C. diagramma* {R} [type of **roskita**]
hipos Labridae *C. trilobatus* {R, I} [type of **linhawan**; brown, there are different colors of **linhawan**; **priko** (green, compressed body, head bigger than body) all 3 have big front teeth)][a] [not a type of **linhawan**][b]

hiringhitin Caesionidae *C. pisang* {R} [type of **roskita**]
hurabas Unidentified [similar to **maya-maya** (Lutjanidae) in appearance; red scales, white belly, small black spot on tail, found in coral and deep waters]
huruhindas Centriscidae *A. strigatus* {I}
igat Eel [type of **labong**]
iitay Unidentified *Misgurnus fussilis*? [found in sea grass beds, not caught or eaten]
iito Plotosidae *P. anquillaris* {I} [2 kinds: **iito** white, **hito** brown]
ilid Unidentified Labridae? [usually on sand] [[swims with **maringyan**][b] which was classified as Labridae by Dioneda et al. 1995] [white body with yellow stripes] [white with brown *batik*?]
iliw Exocoetidae [flying fish]
iliwon Scombridae *T. alālunga* {R} [type of **bangkulis**]
indong Eel [type of **labong**]
itang Platicephalidae *P. indicus* {I}
kabalyason Scombridae *Rastrelliger brachysoma* {R} [type of **buraw**]
kabang Serranidae *Plectropo melanoleucus* {R} [type of **banolog** which is type of **baraka'**]
kabasi Dorosomidae *A. chacunda* {I}
kalibangbang Zanclidae *Z. cornutus* {R}
kalpion Carangidae *C. fulvogutatus* [type of **maligimango**]
kamasuhon Lethrinidae *Lethrinus sp.* [similar to *L. ornatus* but deeper and rounder body][a] [juvenile = **bulao**]
kanasi Nemipteridae [type of **bisugo'**][b] [type of **manambulao**; also is a superordinate taxon including **kanasi** and **bisugo'**][a]
kayangahon Unidentified [caught at 80 *dupa'* with tuna, sold as 1st class fish]
kikyero Unidentified [smells bad, tastes good] [looks like **talakitok** [a Carangidae] black in water, white when speared and dead, adult 5.5" deep and 8" long]
kilaw-kilawan Caesionidae *C. lunaris* [blue type of **roskita**]
kini' Echenedidae *E. naucrates* {I}
kiskisan Clupeidae [juvenile form of **alubaybay**] [type of **maripati**]
kitong Siganidae *Siganus spinus* {R} [has horns, grouped with **bataway** and **turos**]
kugaw Polynemidae *P. microstoma* {I} or *Eleutheronema tetradactylum* {R}[a] [also called **tigi'**]
kupapha' Unidentified
kugtong-baraka' Serranidae *Aethaloperca rogoa* {R} [type of **baraka'**, adult form of **ngipaun**]

kuwaw Pricanthidae *P. macracanthus* {P}
kuyog Siganidae [fry harvested for *bagoong*]
labahita Acanthuridae [type of **mungit** (which is **surahan** in Bikol, **mungit** is Visayan]
labong Eel [superordinate category for Muraenesocidae and Muraenidae]
lahingan Muraenidae [a type of **labong**]
lamadang Coryphaenidae *Coryaphaena hipporus* {I}
lambadoc Caesionidae [kind of **roskita**, red-orange, similar to *Caesio erythrogaster* but a bit wider, usually at 40-70 *dupa*']
lambingan Holocentridae *A. cornutus* {R} [red all over with yellow dorsal fin] *Flameo sammara* {I}
lana' Serranidae [type of **baraka'** also **rana** (Tagalog); looks like **banolog**, but has wide body]
langisiyaw Stromateidae {R}
langkoy Trichiuridae *T. haumela* {I} [I says term is **espada**, 3 varities recognized]
lapad Scombridae? [type of **pundahan**]
lapis Scombridae *S. sp.* {I} [a very "white" fish; same form and same group as **talang-talang**; maximum length 6"]
lapug Serranidae [type of **baraka'**]
lapu-lapu Serranidae [Tagalog, but frequently used to refer to **baraka'** superordinate term]
lidong Pomacanthidae *Apolemichthys trimaculatus*; *Centropyge bispinosus* {R}[a] [or **pulang daghan** (**pula** = red, **daghan** = chest/breast) some types have red bellies, others have yellow][a]
lidong Pomacentridae types: **lidong sa malalim** (Chromis dimidiatus {R}) and **lidong sa mabawa** (Dascyllus reticulatus {R}) [green, looks like **buring, amangpang** and **paso**][b]
linhawan Scaridae [superordinate category]
linhawang-asul Scaridae [blue **linhawan**]
linhawang-dilaw Scaridae [yellow **linhawan**]
linhawang-itom Scaridae [black **linhawan**]
linwahang-puti Scaridae [white **linhawan**]
lipatang Engradulidae *Stolephorus indicus* {I} [type of **bulinao**]
lison Carangidae *Caranx hippos* [Tagalog and Bikol term; grouped with **malagimango**][a] {RB} [Visayan term]
makitayong Lutjanidae [similar to **mayamaya**, but bigger]
malagaas Lethrinidae *Lethrinus ornatus*? {I} [grouped with **dugso'**, **bukhawon**, etc. in the market]
malagimango Carangidae *A. ciliaris* {I,R}

malasugi Istiophoridae [also superordinate category for swordfish and other marlin]
maming Labridae [type of **linhawan**][a]
manambulao Nemipteridae [type of **bisugo'**][b] [also superordinate, grouped with **sapi'**][a]
mamsa' Carangidae *U. mentalis* {I}, *C. melampygus* {R} [type of **malagimango**][a]
manabang Sphyraenidae *S. jello* {I}, *S. barracuda* {R}
manutong Shark [type of **pating**]
marangsi' Lethrinidae [**bukhawon/dugso** type]
maringyan Labridae *Halichoeres hortulanus* {I} type of **palata'** [type of **linhawan**][a]
maripati' Clupeidae [superordinate term]
matangbaka Carangidae *Scomberoides crumenophthalmus* {I} [adult **abubngon**]
maya-maya Lutjanidae *Lutjanus malabaricus, L. fulvus, L. gibbus* {I}
mirapina Carangidae? {P} [silver with yellow fins, compressed] [a "white" fish, translucent body, emits slime when held; grouped with **tagiptipon** and **tarakitok**]
mublad Siganidae *Siganus vermiculatis* {I}; *S. corallinus* {R} [smells bad tastes good] or *S. punctatus* {R}[a,b] [type of **bataway**]
mulmol Scaridae [Tagalog, Visayan, and Bikol term; superordinate term used as alternate for **linhawan**]
mungit Acanthuridae *A. nigrofuscus* {R} [type of **labahita**, smell bad, taste good] or [superordinate category with types **mungit, labahita**, and **surahan**][a] *N. unicornis, N. lituratus* [Visayan, **surahan** in Bicol]
murinay Sparidae *A. spinifer* {I}
ngipaon Serranidae Aethaloperca rogoa {R} [type of **baraka'**, juvenile form of **kugtong baraka'**]
ngipunan Scombridae [type of **bangkulis**]
nordiste Carangidae *D. kurroides* [type of **sibubog**]
nupo' Scorpaenidae *Dendroscorpaena sp.*
oga-og Mobulidae [type of **pagi**]
olob Xiphiidae *X. gladius* [other term for **big-ho'**, type of **malasugi**]
oso-os Sillaginidae *S. sihama, S. maculata* {I}
pagi Dasyatidae *D. sp.* {I}[also superordinate category for all rays—Mobulidae and Dasyatidae]
paging-natural Dasyatidae [type of **pagi**, green with *batik*]
pagotpot Leiognathidae
pak-an Carangidae *Megalaspis cordyla* {I, R} [type of **malagimango**]

palad Bothidae/Cynoglossidae *Bothus pantherinus, E. grandisquamis* {R}[c] [*B. pantherinus* is similar to **palad** found in shallow areas while *Cynoglossus cynoglossus* {R}[a] is similar to **palad** found in deep areas]

palata' Labridae? [also superordinate term, two types: **palatang bungog** (black) and **tunay na palata** (green)][b] [type of **linhawan**][a]

pampano Carangidae

panangitan Muraenidae *Echidna nebulosa* {R}[type of **labong**]

pandawan Rachycentridae *R. canadus* {I} [female = **pandora**]

parangan Apogonidae *A. poecilopterus, A. quadrifasciatus* {I}

paranganon Scombridae [type of **bankulis** (*Thunus albacares*)]

pasa-pasa Mobulidae *R. javanica* {I} [type of **pagi**]

paso' Pomacentridae? [black and small]

pating Shark [superordinate category]

pugot Balistidae *A. tomentosus* {R}[c] *Balistes aculeatus, B. conspicillum, B. fraenatus, B. undulatus* {R}[a] *M. scopas* {I} [also **sulay-bagyo**—Visayan and Tagalog term {I}]

pulang baraka' Serranidae [type of **baraka'**, small, less than 8", red]

pundahan Scombridae Katsuwonus pelamis {R} [type of bangkulis]

putro Unidentified ?

rana' Serranidae [Tagalog, type of baraka' also **lana** (Bikol)]

roskita Caesionidae [superordinate category] [same as Tagalog term **dalagang bukid**][a,b] [also identified as *Caesio pisang* {R}][a]

sablihan Shark [type of **pating**]

sakmo' Leiognathidae [Tagalog, **takmo'** in Bicol] [type of **sap-sap**][a]

salay-salay Carangidae *Alepes djeddaba* {I, R}

sal-igan Lethrinidae *L. rhodopterus* {I} [caught at night] [or **malagaas**?]

sandig Siganidae *Siganus gottatus* {I} *S. punctatissimus* {R}[a,b] [type of **bataway**]

sapi' Lutjanidae *Aphareus rutilans* {R}[a] [type of **manambulao = bisugo'**][a]

sapludan Haemulidae [type of **alatan**]

sapsap Leiognathidae *L. splendens, L. bindus, L. insidiator* {I, R} [adult form of **barorog**][b]

sibubog Carangidae *Decapterus sp.* [**galunggong** in Tagalog]

sigwil Hemiramphidae [type of **bugiw**]

sikwan Fistularidae [also superordinate category]

sirum-sirum Engradulidae? [black, type of **bulinao**][a] [not a type of **bulinao**][b]

suga Holocentridae *Myripristis sp.* {I}

sulig Caesionidae *Caesio sp.* [type of **roskita**] [also **solid** and referred to as type of **dalagang bukid**] [*C. erythrogaster* and *C. lunaris*]

surahan Acanthuridae *N. unicornis, N. lituratus* {I}
surudan Shark [type of **pating**]
tabangungo Ariidae *Arius maculatus* {R} [**kanduli** (Tagalog)]
tabarong Ostraciidae *O. gibbosus* {R} [lives on sand]
tabios Leiognathidae
tabudlo' Lutjanidae [same color as **malagaas** but eyes protrude]
taga-rinas na baraka' Serranidae *Epinephelus fasciatus* {R} [type of **baraka'**]
tagbak Blenniidae *S. faciatus* {R}
tagiptipon Carangidae *C. sexfaciatus* [type of **malagimango** with black spots; also called **ariwan** in Partido Area and Camarines Sur]
tagisi' Nemipteridae [type of **bisugo'**][b] [type of **manambulao**][a]
tagkarhon Shark [type of **pating**]
tagparay Chaetodontidae *Chaetodon vagabundus* {R}
takmo Drepanidae *Drepane longimana* {R} [adult term for **barorong**]
talad Labridae *C. inermis* {I, R}
talakitok Carangidae *C. armatus* {I} [type of **malagimango**; **tarakitok** (Bikol), **talakitok** (Tagalog)]
talang-talang Carangidae *Scomberomorus commersoni*
taldukan Lutjanidae *Lutjanus fulviflamma* {I} [**bukhawon/dugso** type][a] [grouped with **bukhawon/dugso**, etc. in the market, no superordinate term][b]
tamban Clupeidae [superordinate term **for turay, tapurok, tungsoy, maripati, alubaybay**][a] [superordinate category over **tamban** and **tapurok**, **tungsoy** and **tapurok** only swim together with the **tamban** group][b]
tambong Leiognathidae *Liognathus elongatus* {I} [type of **sap-sap**]
tamulmol Scaridae [parrot fish]
tangigi Scombridae *S. sp.* [Spanish mackerel] [a fish buyer identified a picture of *Rachycentron canadus* as **tangigi**, noting that it is a superordinate term which includes **tangiging natural** and **tangiging batang**]
tangiging-batang Rachycentridae *Rachycentron canadus* {R}
tangiging-natural Scombridae *Scomberomorus commerson, S. guttatus* {R}
tangka' Serranidae *Anyperodon leucogrammicus* {R} [type of **baraka'**]
tangirion Scombridae? [similar in shape to **tangiging natural**]
tapurok Clupeidae [type of **tamban**]
taragbagu Siganidae *Siganus virgatus* {R}
tarambagu Siganidae [similar in appearance to **mublad** and **kikyero**; yellow, red, and white]

tarasi Lutjanidae *Lutjanus lineolatus* {I} [**bukhawon/dugso** type][a] [not a type of **bukhawon/dugso**][b]

tarukugan Carangidae [{I} **taruk-ogan** *C. melampygus*] [type of **malagimango**]

taruungan Scaridae/Labridae? [fish with bulging forehead, can reach up to the size of an automobile; this could only be the napoleon wrasse (*Cheilinus undulatus*)][a] [grouped with **mulmol** (Scaridae), dark green][b]

ti-aw Mullidae [type of **timbungan**]

tigi' Polynemidae *P. microstoma* {I} or *Eleutheronema tetradactylum* {R}[a]

tiki' Synodontidae *Saurida variegatus, Synodus variegatus, Trachinocephalus myops* {R} [also superordinate category]

tikiro Drepanidae *D. punctata* {R}

timbungan Mullidae *Parupeneus sp.* [superordinate including **gurayan, agingoy** and **ti-aw**][a] [earlier this same informant classified **gurayan** as a type of **maripati** (Clupeidae) but also noted that it is a type of **timbungan** (Mullidae)]

tingarog Lethrinidae [similar to **dugso'**]

tipil Caesionidae {R} [type of **roskita**]

torotot Fistularidae [kind of **sikwan**]

tungsoy Clupeidae [type of **tamban**][a] [only swims with **tamban** types][b]

tungtong Labridae? [or Branchiostegidae? *Branchiostegus sp.* {R}] [white with slimy coating on scales; grouped with **ilid** (white body with yellow stripes), **palata** (green body) and **maringyan** (yellow or black) all probably Labridae]

tunong Nemipteridae [also called **tulong** superordinate category including **tulong na puti** and **tulong na pula**] [type of **manambulao**][a] [not a type of **manambulao**][b]

tunong na puti Nemipteridae [white type of **tunong**]

tunong na pula Nemipteridae [red type of **tunong**]

turay Clupeidae [type of **tamban**[a], not type of **tamban**, only swims with **tamban**[b]]

turingan Scombridae *A. rochei & A. thazard* {I} [two kinds, **turingan bilugon** and **turingan lapad** meaning round and flat respectively. They say that **turingan** = **burawon** {I} *E. affinis* which could account for the round/flat descriptions?]

turos Siganidae *S. canaliculatus* {I,R} [stays above corals. Lives in **mariw-bariw**] [always schooling]

turukturukan Serranidae [type of **baraka'**]

tutungan Shark *Carcharhinus melanopterus* {I} [type of **pating**]

tuwakang Engraulidae *Stolephorus sp.* [type of **bulinao**]
ubod Muraenesocidae *M. cinereus* {I} [type of **labong**]
ugapo Serranidae *Epinephelus fuscoguttatus* [also superordinate term]
ugdok Muraenesocidae *Synbranchus bengalensis* {I} [type of **labong**]
ukag Lutjanidae *Tropidinius zonatus* {P} [orange with vertical yellow stripes, yellow tail]
ulapay Labridae/Scaridae? [drools underwater, also called **linhawan**] [grouped with **linhawan** and **mulmol**][a]
wal-an Balistidae *O. niger* {R}[c] or *Abalistes stellaris* {R}[a]

NOTES

Various symbols are used in the descriptions of the folk taxa to identify sources which helped in identification. Letters in curly brackets "{ }" refer to the following:

{R} Rau and Rau (1980)
{I} Kuneda et al. (1995)
{RB} list of local names for fish printed out from ICLARM's FishBase
{P} Photograph taken and identified at ICLARM

The superscripts were used to identify key informant sources in cases where heated disagreement occurred. The following are the identifications for future reference:

a Barangay Captain of Atulayan
b Tony from Atulayan
c Others
d Sical from Atulayan

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4

ASPECTS OF THE HUMAN ECOLOGY OF THE CORAL REEFS OF DISCOVERY BAY

Richard B. Pollnac

INTRODUCTION

The purpose of this chapter is twofold: first, to examine selected aspects of the human context of the coral reefs of Discovery Bay, Jamaica; second, to provide comments on the strengths and weaknesses of the methods used to obtain the information as a step in developing a standardized methodology for conducting similar research elsewhere. It represents the second field test of an attempt to develop a set of management-related indicators for a worldwide database on coral reefs (see Chapters 1, 2 and 3).

THE NATIONAL CONTEXT

LAND AND POPULATION

Jamaica, located in the Caribbean Sea some 160 km south of Cuba, has a total land area of 10,990.5 sq km and some 891.2 km of coastline (SIJ 1994). Less than one-half (46.4 percent) of total land area is under pasture and agriculture (NRCD and RMF Ass. 1987). End of year population for 1994 was reported as 2,509,600, with crude birth, death and net migration rates of 23.7, 5.4 and -7.5, respectively, resulting in an annual growth rate of 1.1 percent (SIJ 1995a). The rate of growth has been close to 1 percent for the last five years (PIJ 1995).

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GENERAL ECONOMY

The 1994 gross domestic product (GDP) was 129,986 million Jamaican dollars (J$) with a per capita income of J$ 51,987.3. The balance of trade was a negative 957.7 million U.S. dollars (US$), having decreased from a negative US$ 1,113.8 million in 1993. Average annual inflation for 1994 was 35.1 percent (PIJ 1995). The Jamaican dollar has been shrinking in value against the US dollar. In 1989 one US dollar was worth J$ 6.5 (SIJ 1990), in 1992 it was worth J$ 22.2 (PIJ 1993), and in 1994 it was worth J$ 33.2 (PIJ 1995). The exchange rate in mid-1995 (US$ 1 = J$ 33.3) suggests that the rate has stabilized.

For the most part, the economy is based on sugar, bauxite and tourism, with 41 percent of the labor force employed in the service sector, 22.5 percent in agriculture, and 19 percent in industry in 1989 (CIA 1994). Fifteen and four-tenths percent (9.6 percent males, 21.8 percent females) of the labor force was unemployed in 1994 (PIJ 1995). Eighteen percent of males and 23 percent of females were listed as illiterate in 1987 (SIJ 1994).

COASTAL ECONOMY

Fish are a desired food item in Jamaica, but the most recent, available figures indicate that the fishery accounted for only 0.3 percent of GDP in 1991 (PIJ 1992). Ten years of landings and value figures published by Espeut and Grant (1990) indicate that while landings were somewhat lower in the last two years of the 1980s, value (in current 1990 prices) has increased (see Table 1). While catches appear to be decreasing, Espeut and Grant's (1990:174) figures suggest that both boats and fishers are increasing. From the best available information they estimate that the number of fishers increased from about 10,000 in 1981 to 17,000 in 1990.[1] This suggests that catch per fisher is decreasing.

Table 1. Fishery landings and value.

Year	Value J$ `000	Amount MT
1980	20,141.3	7893.3
1981	22,708.5	7772.1
1982	24,405.8	7974.6
1983	25,948.5	8134.4
1984	27,818.8	8070.0
1985	32,197.7	7967.5
1986	48,610.0	8057.3
1987	53,069.3	8346.2
1988	48,818.6	6804.0
1989	61,570.9	7257.6

Source: Espeut and Grant (1990:108)

Landings by species (1981) indicate that fish associated with coral reefs form a significant part of the catch (see Table 2). According to Koslow et al. (1994), these coral reef fish have been undergoing heavy exploitation for at least the past several decades, and catch rates of reef fisheries have declined. Accompanying this decline in catch rates, commercially less valuable species make up an increasing percentage of landings. For the south coast, Koslow et al. (1994) write that 62 percent of the catch by weight was made up of fish with a low market value (e.g., Scaridae, Labridae, Sparidae, Mullidae, Holocentridae and Acanthuridae). Clementson (1992) notes that there has been a steady increase in the percentage of parrotfish (Scaridae) from 1981 to the present.

Table 2. Landings by species, 1981.

Fish Type	Landing `000 lb	Value J$ `000
Snapper	1,971	5,637
Parrot	1,767	4,461
Tuna/bonito	368	964
Goatfish	601	1,587
Jack	1,282	3,521
Herring/sprat	2,337	2,313
Kingfish/wahoo	256	675
Mullet	161	416
Grouper/hindes	904	2,170
Dolphin fish	241	566
Goggle eye	128	318
Mackerel	81	214
Triggerfish	468	649
Grunt	1,190	2,831
Lobster	518	1,587
Shrimp	22	103
Turtles	126	280
Other	3,485	6,234

Source: Sahney (1982)

These apparently decreasing fish landings are all the more significant when considered in light of the fact that for decades, the demand for fish and fish products has exceeded supply. Over 20 years ago, Munro and Thompson (Munro 1983) wrote that large amounts of fish are imported to meet this unsatisfied demand. Table 3 details fishery imports for 1994.

Perhaps the most important economic aspect of the coastal environment is its tourist industry, most of which is coastal in nature. In 1994 earnings from tourism were about 23 percent of GDP, and tourism has manifested an increasing growth trend over the past decade (Table 4), except for several small decreases in 1988 and 1994.

THE REGIONAL CONTEXT

For purposes of this report, the regional context of Discovery Bay is defined as the watershed within which it is located. An environmental profile of Jamaica (NRCD & RMF Ass. 1987:119) indicated that almost all of St. Ann Parish is defined as one watershed area. This is probably due to the limestone underlying the area which is very permeable and characterized by numerous underground streams. Scientists from the Discovery Bay Marine Laboratory (DBML) report numerous freshwater springs bubbling from the bottom of the bay.

St. Ann Parish is located in the central part of the north shore of Jamaica (Figure 1). The total area of St. Ann is 1212.6 km^2 with a coastline of 53.8 km. The parish has 1,007 meters of public bathing beaches and 500 meters of fishing beaches (SIJ 1994). The population of St. Ann Parish was 150,700 in 1991, having increased from 137,700 in 1982 (SIJ 1995a). Most of the major population centers of the parish, except for Brown's Town, are located on the coast (Table 5 and Figure 1). In October 1994, there were a reported 65,800 in the labor force, made up of 36,800 males and 29,000 females. Of this total 10,200 (15.5 percent) were

Table 3. Fishery imports for 1994.

Category	Value US$ `000
Fish fresh/ frozen/ chilled	1,858
Canned herring	181
Mackerel salt/ dry	5,676
Canned sardines	4,433
Cod dry/ smoked/ salt	1,858

Source: PIJ (1995)

Table 4. Number of tourists and earnings.

Year	Stopover	Cruise	Earnings US$
1985	571,713	261,508	406.8
1986	663,593	278,507	516.0
1987	738,827	292,156	595.0
1988	648,873	367,732	525.0
1989	714,771	444,054	593.0
1990	840,777	385,205	740.0
1991	844,607	490,473	764.0
1992	909,010	649,517	858.0
1993	978,715	629,587	942.0
1994	976,635	595,032	915.0

Source: PIJ 1995, 1992

reported as unemployed (3,900 (10.6 percent) males and 6,300 (21.7 percent) females. A year previously, 10,200 (15.2 percent) out of a labor force of 67,000 were unemployed (37,500 males and 29,500 females, with 3,800 [10.1 percent] and 6,400 [21.7 percent] unemployed, respectively) (SIJ 1995b). As of December 1994, St. Ann, which includes 6.2 percent of Jamaica's population, received 7.9 percent of the country's food stamp assistance (PIJ 1995). Land use for St. Ann Parish was estimated from a land use map (NRCD & RMF Ass. 1987:265). Ordinal estimates of land use, arranged from most to least are mixed farm, scrub woodland, forest, banana, sugarcane, coconut and urban. Almost equal areas are devoted to banana, sugarcane and coconut. Most of the parish has minable bauxite resources (NRCD & RMF Ass. 1987:230), and mining operations are carried out in several parts of the parish.

Table 5. Population of major towns in St. Ann.

St. Ann's Bay	11,100
Ocho Rios	8,500
Brown's Town	6,700
Runaway Bay	5,600

Source: SIJ (1995a)

The north shore of Jamaica is characterized by a relatively narrow shelf (less than one-km wide), making it acutely sensitive to fishing pressure (Woodley 1994) as well as pressures from tourism and other anthropogenic stress factors. Espeut and Grant (1990) provide an estimate of 0.13 boats and

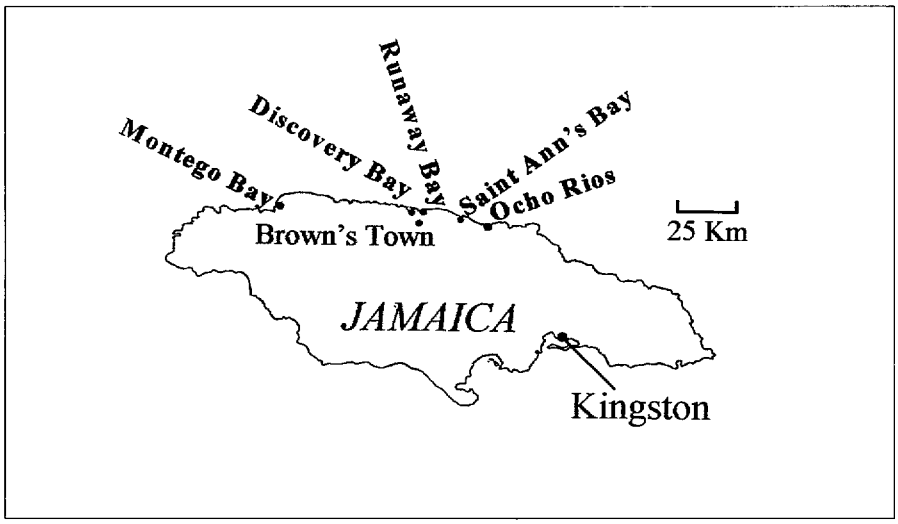

Figure 1. Jamaica with places named in text.

0.20 fishers per ha on the north coast, in contrast to 0.02 boats and 0.05 fishers per ha on the south coast. Total number of fishers in St. Ann Parish is unknown.[2]

Tourism forms an important part of the parish's economy, with numerous hotels, resorts and villas (furnished houses rented to tourists) in coastal locations and towns. A total of 3,400 hotel rooms are listed (JTB 1995) for Ocho Rios and Runaway Bay, with Ocho Rios having the majority (2,778). Guest houses add another 38 rooms to Ocho Rios. Additionally, Ocho Rios is Jamaica's most active cruise ship port with some 300,000 cruise and 400,000 overnight passengers in 1994, and work is now in progress to expand pier capacity to accommodate superliners capable of holding 2,600 passengers in contrast to the current 1,500-2,000 (Shaw 1995). Although no figures are available, tourism obviously forms an important source of employment for the people of St. Ann Parish. This employment includes a wide range of activities associated with the hotel, restaurant, beach, guided tour, recreational fishing and diving, and transportation services connected to the tourist industry. Many of the unemployed in the region see tourism as a source of employment and move to tourist towns where they either find a job, make one or join the unemployed. Tourist towns like Ocho Rios are characterized by sidewalk vendors and ramshackle roadside food stands (called shacks) which seem to increase like weeds, overloading available public services (e.g., waste disposal, water, etc.) and causing concern for resource pollution.

DISCOVERY BAY

THE MARINE CONTEXT

Discovery Bay opens northward into the Caribbean Sea on the north coast of Jamaica. The bay is nearly circular, 1.6 km across at its widest point, with a mouth about 1.3 km wide (Figure 2). A mostly vegetated, rocky, limestone coastline, spotted by beautiful white sand beaches surrounds the bay which is separated from the sea by a reef crest, some of which is above sea level. Total coastline within the bay is approximately 5.4 km. A 12-m deep by 120 m-wide ship channel was blasted through the reef crest in 1964. The deepest part of the bay is 55 m, but much of the perimeter of the bay is characterized by shallows made up of coral rubble, isolated coral heads, patch reefs, mixed sandy bottom and sea grass beds (Sary 1995).

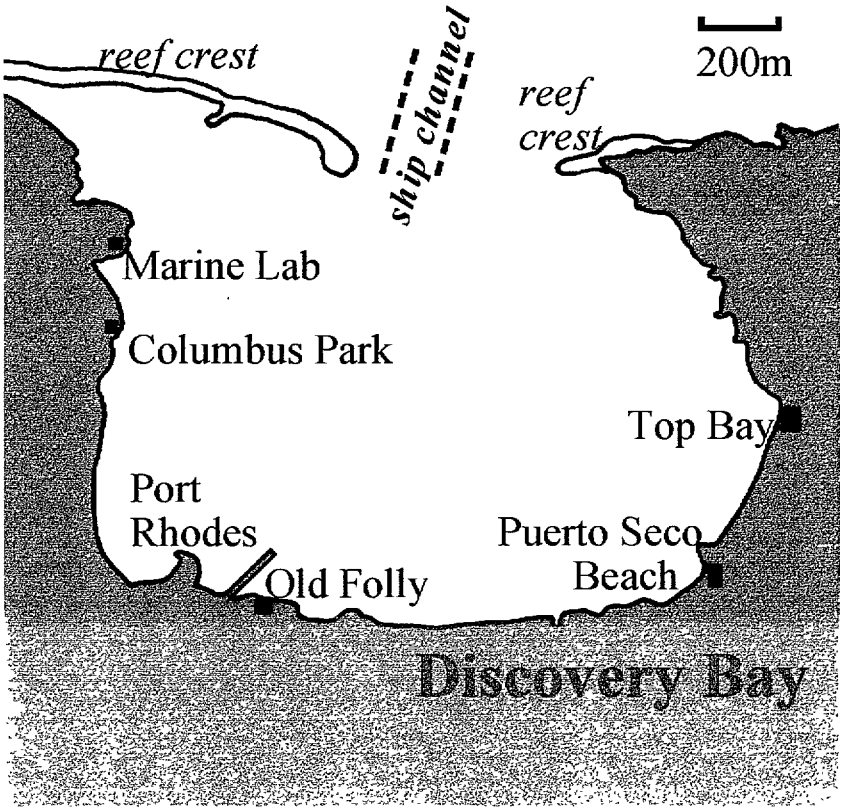

Figure 2. Map of Discovery Bay with locations named in text.

THE HUMAN CONTEXT

Discovery Bay is a relatively small town whose approximately 1,500[3] inhabitants live either along the coastal highway or along narrow roads or paths leading into the relatively steep hills that back the bay. In terms of business activity, the business center, located near the southeast corner of the bay, boasts of a shopping center with a small supermarket, hardware store, restaurant, bar, clothing store, bakery/fast food store and a beauty shop. Adjacent to this shopping center is a full service bank and a police station. Along the highway, which skirts the business center is a gas station, two convenience stores, another developing shopping center with a liquor store, a Chinese restaurant and a bar. A small coast guard station is on the beach, adjacent to the business center. To the east, along the highway and outside

the central business district, are several small stores, bars, a small guest house (seven rooms) and the post office. Several other businesses (a real estate office, beverage distributor, food stands and general purpose stores) are thinly scattered along the highway as one leaves Discovery Bay and moves towards the east.

Just to the west of the business center is the largest tourist hotel/villa in town. As one moves westward along the highway, a small concentration of food and grocery stands and a restaurant is located near Old Folly beach. Small grocery stands are also scattered throughout the side roads of the community. The University of the West Indies DBML is located at the northwestern corner of the bay.

The town's largest employer is the Kaiser Jamaica Bauxite Company, which employed some 552 workers as of May 1995. The company's central office in Discovery Bay is located in the hills behind the business center. The plant where bauxite is processed is off the southwest corner of the bay, inland from the pier from which the product is shipped in large ocean going vessels (Port Rhodes, see Figure 2), its activities casting a reddish dust throughout this region of Discovery Bay. Mines are located some 14 miles inland.

Primary, but no secondary education is available in Discovery Bay. There is no hospital or resident doctor or dentist. A medical clinic associated with the Kaiser Bauxite Plant has a clinic administrator, nurse supervisor and medical technologist. Several Christian churches serve the religious needs of the population. Potable, public water supplies are available from central standpipes or piped into the home. Toilet facilities for the most part are either water closet with septic tank or outhouse with a pit.[4] Observation indicates that some of the coastal dwellings (including some tourist villas) discharge waste directly into the bay. The paved, two-lane north coast highway connects the town with the rest of Jamaica. Frequent minibus services carry residents to other north coast towns, including Ocho Rios, where bus service to Kingston runs throughout the day.

THE PEOPLE

As in any small, modern town, there is a diversity of occupations in Discovery Bay. By far the largest employer is the Kaiser Jamaica Bauxite Company, employing a total of 552 distributed among 204 hourly workers in the plant, 194 hourly workers in the mine and 154 salaried workers. Some of Kaiser's employees do not reside in Discovery Bay. The service sector, staffing the numerous shops and other businesses described above, probably provides the next largest number of jobs.[5] Many of the jobs associated with the tourist industry (e.g., cooking, housekeeping, grounds maintenance, taxi and minibus

driving, life guarding, security, etc.) would contribute significantly to employment in the service sector. Continuing construction of houses, villas and places of business provides employment for individuals in the building trades. Limited agriculture in the hills surrounding Discovery Bay and fishing also contribute to local incomes. Many of the 76 fishers[6] of Discovery Bay are part time,[7] finding other part-time, and sometimes full-time employment in one of the other occupational categories listed above.

Discovery Bay is ethnically relatively homogeneous in the sense that most inhabitants are Jamaican, Jamaicans being a complex combination of many ethnicities. There is no overwhelming presence of tourists, as in Ocho Rios. Most tourists are seen in rental cars, taxis and minibuses, speeding through town on the coastal highway on their way to the expensive resorts in Runaway Bay or Ocho Rios. Some stop for refreshment at one of the convenience stores near the gas station or at Columbus Park, but their presence is small. Social heterogeneity in Discovery Bay is based more on income and education than ethnicity.

Lacking current detailed data on distribution of education, income distribution data and information gained from observation can serve to illustrate this heterogeneity. Education and income are frequently correlated.[8] First, with respect to observations made in the community, some inhabitants live in hastily constructed shacks on the hillsides overlooking the bay, while some live in large modern houses. Many walk or catch minibuses to their destinations, while some cruise in luxury automobiles or fully equipped pickup trucks. Some of the highly paid Kaiser Jamaica Bauxite staff actually go 'home' to luxury in Kingston on the weekends. Data related to income distribution was only available by parish, and the data for St. Ann is presented along with the national data in Table 6.

Table 6. Cumulative percent distribution of monthly household consumption expenditure.

J$	Jamaica	J$	St. Ann
<1,000	4.3		
<2,000	16.9		
<3,000	31.5	<3,000	30.9
<4,000	46.2		
<5,000	58.7		
<6,000	68.5	<6,000	70.6
<7,000	76.0		
<8,000	81.7	<8,000	83.6

Source: PIJ and SIJ (1994)

Data for St. Ann was not as detailed as that for the rest of

the nation, but there seems to be only minor variation from the national data for the three categories reported; hence, we might tentatively assume that the detailed distribution in St. Ann would be similar as well. This distribution indicates a relatively high degree of income inequality in St. Ann Parish and in Jamaica as a whole. Thomas (1994) notes that Jamaica has consistently shown the highest level of income inequality in the Caribbean. Figures from 1989, 1991 and 1992, however, suggest that the situation is improving a little. Mean per capita consumption of the top 10 percent of the population fell from 16.4 times the bottom 10 percent in 1989 to 13.7 in 1991 and 12.8 in 1992. In 1992, the poorest 10 percent had an average per capita consumption of J$ 3,863, representing a share of 2.58 percent, while for the wealthiest it was J$ 49,360 or a share of 29.59 percent (PIJ and SIJ 1994).

A general indicator of quality of life in Discovery Bay can be determined from the infant mortality rate. This is a fairly good measure of general nutrition and health care, indicators concerning satisfaction of some basic human needs. Newland (1981:5) writes that "no cold statistic expresses more eloquently the differences between a society of sufficiency and a society of deprivation than the infant mortality rate." This figure was calculated by dividing total deaths under one year by total births for the years 1989-1991 and multiplying by 1000. This results in the infant mortality rate per thousand. Data for infant mortality calculations was derived from SIJ (1995a). Infant mortality for St. Ann Parish for the years 1989-1991 was 20.9. This compares unfavorably with the national rate of 11.3 for the years 1990-1991. St. Ann Parish's rate for this same time period was 18.8. Examined on a yearly basis, however, the rate is dropping both nationally (1990, 13.1; 1991, 9.5) and for St. Ann (1989, 27.5; 1990, 19.9; 1991, 16.2).[9] This information was not available at the level of Discovery Bay.

USE OF THE CORAL REEFS

At present fishing, gleaning, tourism and research constitute the only direct use of the coral reefs of Discovery Bay. In the past (1964), a 12-m deep by 120-m wide ship channel was blasted through the reef crest to permit entry of large, ocean-going, cargo vessels to serve the Kaiser Bauxite operation. Construction of the pier at Port Rhodes also probably had an impact on patch reefs close to shore, but this is unknown at the present time.

TOURISM

Discovery Bay has a great deal of natural beauty with its azure waters,

coral reefs and white sand beaches. Contributing to this beauty are the tree-covered hills, spotted with houses, which rise abruptly from the coast. Caves in the limestone hills provide another attraction. Alleged by some to be a landing spot for Columbus in his exploration of the Americas, it also has a historical attraction for tourists.

Tourists can stay at a seven-room guest house, a small hotel (Portside Villas), or one of the 10 registered or estimated 30 unregistered villas[10] in Discovery Bay. Piers for visiting yachts are attached to some of the villas and the Portside Villa Hotel. Tourist activities observed include sunbathing, swimming, jet skiing, water skiing, beach combing (including wading and diving in the shallows where some coral reef patches remain) and diving. The individual who ran a diving operation at the hotel ceased operations in mid-1995 and moved his operation to Runaway Bay, where there are several other dive operators. When asked why, he said, "The bay's a disaster. Most of the coral's gone, the visibility is bad and there are few fish." In mid-1995 there were no dive operations in Discovery Bay other than those associated with the DBML of the University of the West Indies. The laboratory has facilities for visiting scientists and students; hence, it could be considered as a contributor to 'scientific tourism' as well as the economy of Discovery Bay.

There are far fewer tourists in Discovery Bay than in more popular spots on the north coast such as Montego Bay, Runaway Bay and Ocho Rios. Tourists are usually seen through the windows of rental cars, minibuses, and buses, as they speed along the north coast highway on their way to other destinations. Some of the tours, however, stop at local attractions such as Columbus Park, a free, open air museum sponsored by Kaiser Jamaica, with several souvenir stands and a beautiful view of Discovery Bay. Other tourist stops include Green Grotto, limestone caves to the east of town reputed to have been a hiding place for the Spanish as they were escaping the island in the mid-17th Century. Puerto Seco Beach, also sponsored by Kaiser, is on the coast, adjacent to the business center, but few tourists use its facilities. On weekends it is crowded with local youngsters and adults, enjoying the sandy beach and shallow waters.

FISHING AND GLEANING

There are two fishing beaches, places where fishers land their catches and beach their boats, along the coast of Discovery Bay. Top Bay, on the east side of Discovery Bay, is a landing site for over half the local fishers. Facilities include running water, a cement floored shed with equipment storage lockers, and a scattering of benches and a few tables. A 'lunch-stand' style restaurant, with some tables and benches under trees on the beach serves baked fish and

corn 'dumplings' as well as beer and other drinks. It is frequented by local elites, as evidenced by the expensive automobiles and fully equipped pickup trucks that deliver the customers. The second fishing beach is Old Folly, located on the south coast of the bay, just east of the Kaiser Jamaica pier (Port Rhodes). Facilities at Old Folly include two buildings: one small building housing a repair shop and supply store, and another, larger building where fishers store their gear and hold meetings. Both buildings belong to the Alloa Fishermen's Association (also referred to as the Discovery Bay Fishermen's Association). It was announced in mid-June 1995 that the association was awarded a grant from the Canadian High Commission "Green Fund" (over J$ 500,000) to build a new building on Old Folly Beach. It will house the gear store, a gear locker, a kitchen/bathroom and a room for a caretaker.

The fishers of Discovery Bay target, for the most part, coral reef related fish. Pelagics that pass through or by Discovery Bay are also caught when available. No gleaning for human consumption was reported or observed. The only gleaning observed and reported was for the *soldier crab*, the hermit crab which is used for bait and chum.

Technology and methods. The predominant fishing method used in Discovery Bay is trap fishing, practiced by some 34 fishers. This is followed by spear fishing (21 fishers), hook and line (16 fishers) and net fishing (five fishers). Most of the fishers, except for divers, use relatively small (6 m or less) wood vessels. About 12 percent use larger (8 to 10 m) fiberglass boats. The wooden vessels manifest a wide range of construction techniques, including dugout, dugout built-up with plank, plank built and a few plywood. Of the 58 boats counted on the two fishing beaches, 49 looked like they were frequently used. Four looked seaworthy, but a bit neglected and high on the beach, and five were derelict, with rotted portions and holes in the side or bottom. Most fishing operations and landings observed used unmotorized vessels.[11]

Trap fishing. Traps used by the Discovery Bay trap fishers are of the Antillean trap type: Z-shaped, approximately 5-ft long, 4-ft wide, and 2-ft deep wooden frame, covered with a mesh of galvanized wire (Munro 1973). According to Sary (1995) 34 of the approximately 75 active fishers in Discovery Bay are trap fishers, deploying some 285 traps, most of which (54 percent) use 1.25" mesh. Forty-two percent of the traps use the recommended 1.5" mesh, and only 4 percent use 1" mesh. Most trap fishers (19) use their own small (<7 m) wooden unmotorized boats. Two use small wooden motorized vessels; seven fishers deploy their traps from larger (>8 m) motorized fiberglass boats. Six of the trap fishers do not own a vessel and

either rent a boat or go out with other fishers. There is usually only one fisher associated with a fish trap operation. However, crews of two or three were observed on the larger, fiberglass vessels.

Of 332 fish trap sets with known location, 84 percent were located on the fore reef slope at depths between 8 and 32 m. Eight percent were located inside the bay between one and 24-m deep, and another 8 percent were located close to the ship channel at depths between five and 12 m. Traps are left in the water for a mean of 3.5 days (Sary 1995). It is interesting to note that fishers say they set their traps between 20 and 30 m to keep them out of the diving range of spear fishers, who they blame for theft of fish. The water is so clear that they can be seen from the surface, thus eliminating the need for marker buoys which could facilitate theft by other boats (Sary 1995). Some trap fishers use a 1-ft square box with a glass or plexiglass bottom to view the contents of their traps through the surface water.

Sary's (1995) research indicates that most of the trap fishers are part-time, with other sources of income. About one-fourth work part of the year at the Kaiser Jamaica Bauxite company, one-fourth are involved somehow in the tourist industry, and the other half are either self-employed tradesmen or retired (most are over 50 years of age).

Spear fishing. There are some 21 spear fishers who live in Discovery Bay. Spear fishers from other areas such as Trelawny Parish, Montego Bay are reported to come to fish along traditional Discovery Bay fishing grounds due to their recent displacement by the Montego Bay Marine Park sanctuary. In return for a portion of the catch, vehicle owners transport the spear fishers to the Discovery Bay area. One Old Folly resident said that on very calm days she has seen as many as 35-40 spear fishers off the coast, just west of Discovery Bay.[12]

Spear fishers use face masks with snorkel, swim fins, and a homemade or store bought spear gun. Spears used are about 75 cm long and 8 to 9 mm in diameter. They are made of steel and are not barbed. Fishers say the barbs can cause a spear to curve in the water. Face plates of the mask are cleaned with seawater and the leaves from a bush called the soap tree. Spear fishing is usually conducted in the morning, before the wind picks up. Local divers enter the water about one to 1.5 km to the east or west of the mouth of the bay and swim over the reefs along the shore searching for fish. Sometimes they swim back to the mouth of the bay, sometimes to the other side of the bay, depending on catch. If they have to swim to the other side of the bay, they go to the highway and try to get a ride back to their home beach. They usually spend three to four hours searching for fish.

Hook and line. Sixteen fishers are identified as hook and line fishers although many trap fishers troll a baited line while sailing to their traps with hopes of catching something. There are two types of hook and line fishing. There is fishing in the deep, out past the reef in 200 to 300 fathoms of water, and fishing in the shallows of the bay and along the reef. Line fishing outside the bay is conducted from about five miles to the west to four miles to the east. Distance fished is limited by technology and weather. Informants said that even non-motorized boats fish these limits.

Hook and line fishing in the bay takes place either during nighttime or during the day. Fishing is conducted from small, mostly unmotorized, wooden vessels. Crew size is usually one, but sometimes two line fishers share a boat. The fishers use a weighted handline with up to eight hooks attached. The time of day the fishing is conducted depends on the target species. Night fishers use lights and direct their efforts at *goggle eye* (big eye scad), snappers, groupers, jack and herrings. During moonless nights they especially target goggle eye, using a light to attract them. During moonlit nights they target *balarton* (Priacanthidae) and *moonshine conga* (Apogonidae).[13] They frequently fish by the Kaiser pier and out by the channel lights. During the day, in the shallows, *conga tony* (Holocentridae), barracuda and *longjaw* (*Tylosurus crocodilus*) are the targets. Parrotfish are also fished during the day, especially when the sun is bright and the winds have started blowing. Parrotfish are captured on a hook baited with *soldier crab* (the hermit crab).

Sometimes the *goggle eye* is used for bait fishing in the shallow water. Many fishers who are going to pull their traps troll a *goggle eye* on a hook for barracuda or kingfish. Additionally, some shallow water hook and line fishers use chum to attract fish. *Soldier crab* is mashed on a stone which is dropped to the bottom. The smell on the rock attracts fish (especially parrotfish, also snapper and yellowtail snapper). Another technique used is to mash-up the crab with sand and throw the sand where you plan to fish. It also attracts parrotfish. Cooked rice can be used as chum for both *goggle eye* and *balarton*.

Fishing from the deep is usually conducted between 6:30 and 9:00 a.m. The fisher departs before sunrise and stays until the winds pick-up, usually between 9:00 and 10:00 a.m. Most, but not all of the deep-water fishers use small outboard motors (10-20 HP) on their wooden boats. Crew size is usually one, but sometimes two. Fish caught are *satin* (Lutjanidae), *silk* (Lutjanidae), *wrenchmen* (blackfin snapper), day grouper, amberjack, barracuda, and kingfish.

Most deep-water fishers use a weighted line with eight hooks. Length of leader and distance apart vary between fishers, but leaders are usually one to two feet in length and strung far enough apart to prevent tangling (e.g., 15 to 36 inches apart). When targeting barracuda and kingfish, a steel leader is

used. The weight usually rests on the bottom. One or more lines, attached to a white styrofoam float are set. Distance between lines depends on the weather. *Goggle eye* is the preferred bait.

Net fishing. There are five fishers who deploy gill nets in Discovery Bay. The nets used (2.5" mesh) are between 100 and 200 ft long and 50 mesh deep (about 10 feet deep). Target fish are all the reef fish being caught. The nets are set out on the slope area, the seaside of the fore reef, just beyond the reef crest, and attached to the bottom by tying them to the coral or other rocks. Fish are then scared into the nets by several helpers who dive into the water making some kind of a commotion, swimming around and beating the water. At Old Folly, nets are operated by ex-spear fishers who have experience diving around fish. The nets used (2.5" mesh) are between 100 and 200 ft long and 50 mesh deep (about 10 ft deep). Target fish are all the reef fish being caught.

Important target species. Catch composition, in terms of percent landed by family for the years 1990 through 1992, can be found in Table 7. Catch composition

Table 7. Catch composition in percent landed by family.

Family	1990	1991	1992
Scaridae	36.2	42.7	41.1
Acanthuridae	13.0	12.9	11.7
Misc.	9.9	8.4	8.5
Holocentridae	8.8	6.8	3.9
Pomadasydae	5.3	5.1	4.0
Serranidae	5.0	4.9	5.5
Lutjanidae	3.6	3.0	2.4
Clupeidae	3.2	2.8	1.2
Carangidae	2.9	2.3	2.3
Mullidae	2.6	1.6	1.8
Crustacea	1.9	1.4	5.6
Muraenidae	1.4	1.4	1.8
Mollusca	1.2	1.3	1.6
Priacanthidae	1.0	1.2	2.0
Gerridae	0.8	1.2	0.3
Diodontidae	0.8	0.8	1.5
Ostracidae	0.7	0.7	0.9
Pomacentridae	0.6	0.6	0.7
Monacanthridae	0.6	0.5	1.4
Balistidae	0.2	0.5	3.2
Scombridae	0.0	0.1	0.3

Source: 1990 and 1991 data are derived from Picu-Gill et al. (1991); 1992 data from Sandeman and Woodley (1994).

varies somewhat between different fishing methods. Fortunately, recent research in the bay provides us with catch composition for trap fishing, which is the predominant method. This information can be found in Tables 8 and 9. Information of this quality was not available for other types of fishing, but key informant data[14] suggests the following ordinal rankings, from most to least important, for each type: Spear fishing–parrotfish, snapper, grouper, others (mixed coral fish such as *doctorfish*, *butterfish*, *wrenchman*); Hook and line in the deep–*silk*, *satin*, *wrenchman* (deep), grouper, amber jack, barracuda, kingfish; Hook and line in the shallow–snappers, groupers, herring, jack, *goggle eye*, *conga tony*. No data of this type was obtained from the few net fishers in the bay.

Table 8. Top ten species by weight in traps sampled between July and December 1994.

Species	Percent
Sparisoma aurofrenatum	12.1
Acanthurus bahianus	11.4
Acanthurus coeruleus	11.3
Haemulon plumieri	9.8
Lutjanus apodus/jocu	8.1
Sparisoma viride	4.9
Acanthurus chirurgus	3.7
Caranx ruber	2.8
Sparisoma chrysopterum	2.4
Epinephelus cruentatus	2.2

Source: Sary (1995)

Table 9. Percent weight in traps sampled between July and December 1994.

Family	Percent
Parrotfish	24.6
Surgeonfish	26.4
Grunts	13.6
Snappers	11.0
Squirrelfish	5.1
Misc.	4.4
Jacks	4.1
Groupers	3.7
Goatfish	3.0
Trigger & tilefish	2.3
Puffers & boxfish	1.7

Source: Sary (1995)

Marketing and Distribution. Marketing and distribution of fish landed in Discovery Bay differs from that reported for Jamaica as a whole. With respect to Jamaica in general, Espeut (1992) writes that fish are landed in relatively small amounts at over 200 locations all over the country.

All fish landed is sold or used for home consumption. Eighty-three percent go to retail *higglers* (the term used for traders), and 58 percent sell direct to the general public. About half the fishers sell to the same set of *higglers* (average of 3.5 *higglers* that each fisher deals with regularly). In Discovery Bay, demand is so high and landings so low, that customers (some purchase for restaurants, etc., many are individual consumers) wait on the beach to purchase fish directly from the fishers. Fish that are not sold directly on the beach are carried by the fisher to customers in the neighborhood. The current situation differs markedly from that reported by one elderly fisher for the 1940s. He said that there were so many fish that buyers used to come to Discovery Bay from Brown's Town. At that time, they had to land their catches early in the morning to sell them to buyers who wanted to get back inland before the heat of the day.

There are also some fish distributed free, on what appears to be a reciprocal basis. Someone always helps pull/push the fishers' boats ashore. The boats are relatively heavy, plank built or dugout, and wooden log rollers are used to roll the boat from the water up on the beach. It takes a minimum of two people to do this, but there are usually three or four men at the landing (hangers-on, fishers who have already landed, etc.) who are willing to help. They actually jump up as a boat comes in, saying they should go help. Some of the hangers-on receive a small fish in exchange for their help–not every time, but it seems that a debt accumulates and a fisher gives a fish, sometimes only a few leftover baitfish (e.g., *goggle eye*).

REEF GOVERNANCE

LOCAL KNOWLEDGE

While governance of a natural resource is most frequently associated with formal, official government regulations, it is the community of resource users who exercise the most direct control over the resource and who, in their perception, have the most to gain or lose from changes in availability. Their perceptions of the resource as well as the ecological knowledge they have gained from generations of interaction with and dependence on the resource have a direct influence on their resource related behavior. Ecological knowledge of users is a factor increasingly recognized as both influencing receptivity to and providing information significant for governance (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Johannes 1981), use rights and actual management efforts (traditional and/or official), if any.

Local ecological knowledge is related to reef governance in several important ways. First, local knowledge concerning the reef and its associated flora and fauna can contribute to our scientific understanding of this complex ecosystem. Second, an understanding of local knowledge systems can facilitate interactions between reef users and outsiders (e.g., scientists, management specialists, decisionmakers, etc.) concerned with reef issues. Third, knowledge of local belief systems concerning human relationships with reef flora and fauna may help predict and explain reactions to management efforts (for more detail see Chapter 1).

Cognitive mapping. One important aspect of local knowledge includes user conceptualization of the distribution of the resource, including cognitive mapping. While distribution of a resource is a spatial phenomena, reference points in the spatial distribution are converted into concepts which are frequently named, especially if they are important reference points. Hence, users' cognitive maps of the distribution of the resource can be constructed, in part, from named features, fishing spots, etc. Place names elicited from the fishers of Discovery Bay can be found in Figure 3.

The names of some places are obviously derived from shore side structures or place names (e.g., Marine Lab, Fort Point or Airbase Point), and others, significantly, reflect observation of fish behavior at the place. For example, Soldier Wash is the place the fishers say the *soldier crab* comes to wash its eggs. Similarly, Spawn Bay is the place where fish spawn, and Fry Hole is a place where fish fry congregate. Some names refer to species found at the spot (e.g., Hogfish Hole, Turtle Spot, and Lobster Point). Other place names are descriptive of actual features, such as Channel Mouth, Wharf Head and Round Rock. Except for place names reflecting fish behavior, the principles involved in naming are similar to those used by the fishers of Atulayan Bay in the Philippines (see Chapter 3).

Folk taxonomy. Another important aspect of Discovery Bay fishers' ecological knowledge is naming and recognition of aquatic organisms. The number of aquatic organisms distinguished and named by these fishers is relatively large, reflecting both the extent of traditional knowledge they possess (Johannes 1981; Pollnac 1980; Ruddle 1994) and the species diversity characteristic of coral reef areas. The number of organisms named is not as large as that in some other coral reef areas (e.g., the Philippines; see Chapter 3), but this may reflect the relative influence of a tradition of several hundred years of fishing in the case of Jamaican fishers, in contrast to thousands of years in the Philippines.

The folk taxonomy found in Appendix I lists a large number of marine organisms distinguished by the fishers of Discovery Bay. It is referred to as a 'folk taxonomy' to reflect the fact that it is a list of names shared by a community of fishers in contrast to a 'scientific taxonomy' which is usually shared by an international community of scholars. Both types of taxonomies, however, are based on observations of similarity and difference; both are based on a type of science—the 'folk taxonomy' on folk science, the 'scientific taxonomy' on internationally established scientific procedure.

Folk taxonomies, however, reflect more than a listing of names. They also reflect processes by which humans organize the diversity in their environment, and this organization of diversity is frequently influenced by other social and cultural variables (Berlin 1992; Brown 1984). The most obvious, long-recognized example of this process is the observation that taxonomic categories with cultural significance are frequently characterized by a large number of named subcategories (Berlin et al. 1966). For example, staple crops are characteristically subdivided into a relatively large number of named types among traditional farmers; people concerned with snow (e.g., skiers or Eskimo) have more named varieties of snow than others, etc. Likewise, the fishers of Discovery Bay have more named types of fish than

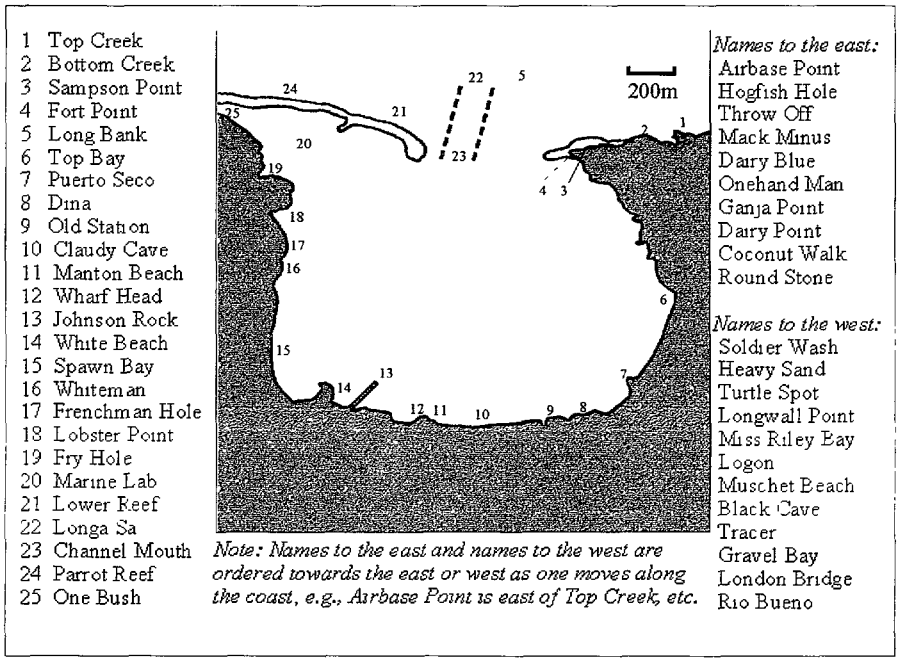

Figure 3. Fishers' place names for locations in Discovery Bay.

non-fishers. Although fish dealers and consumers know many types, their knowledge does not equal that of the fishers, and they frequently refer to the types using higher level (or more general, or more inclusive) taxonomic categories. If a number of species manifest similar culinary attributes, the dealer and consumer need not refer to them by specific type (e.g., hammerhead shark) but need only refer to them in terms of a more general category (e.g., shark). As will be seen below, these general principles are reflected in the folk taxonomy of fish in Discovery Bay.

The more general categories in a folk taxonomy also function to facilitate learning and memory. They cluster types which share some features in common into groups, and the name of the group, which elicits in memory the features shared in common, also acts as a key, or mnemonic device for stimulating recall of the specific types. Once again using the 'shark' example, a child probably learns the term 'shark' first,[15] then learns that there are other types of shark. In this case, the superordinate category functions to organize the complexity of more specific categories in the taxonomy. Both of these processes (simplification of complexity where details are not needed and organization of complexity to facilitate learning of the details) appear to be reflected in the folk taxonomy of aquatic organisms used by the fishers of Discovery Bay.

From this point forward, certain conventions will be adhered to with respect to terminology used in describing the folk taxonomy of the fishers of Discovery Bay. Levels in a taxonomy will be referred to as ranks. Shark is a taxon at a more inclusive rank than the taxa hammerhead shark and nurse shark. The term 'shark' refers to more organisms than the term 'hammerhead shark,' hence, it is considered more inclusive. The high degree of similarity between folk taxonomies and scientific taxonomies has led anthropologists to use many of the same terms as biologists in describing the structure of folk taxonomies (Berlin 1992). For example, anthropologists use terms like 'generic rank' and 'specific rank.' These are not always coterminous with the biologist's application of the terms because folk taxonomies have fewer ranks;[16] hence, the terms will be modified by the term 'folk' in this chapter. When referring to the generic rank in a folk taxonomy, it will be labeled 'folk generic,' etc.

It only takes a quick glance at the folk taxonomy in Appendix I to see that the parrotfish (Scaridae) are distinguished by a large number of named taxa. This probably reflects their growing importance in the catch as other types targeted by fishers have been heavily over fished (Clemetson 1992). The folk generic taxon *parrotfish* will thus be used to illustrate some of the salient aspects of the folk taxonomy of the fishers of Discovery Bay. First, and most obvious, there are 25 distinct terms used to label the 13 species

distinguished by the scientific community. This excess in number of terms used by the Discovery Bay fishers reflects two facts.

First, some parrotfish manifest marked changes during their life cycle. Among some species, juveniles, male and female, look alike; but as the fish mature, the color and size of the male becomes greatly distinguished from the female. Among some other species, adult males and females look alike, but there is a terminal stage referred to as 'supermale' which is much larger and differently colored from the female, as well as being relatively uncommon according to some authors (Robins et al. 1986). Five of these highly differentiated males are referred to with distinct terms by the fishers of Discovery Bay. The total number of species and distinct males accounts for 18 of the distinct terms. The remaining seven reflect the fact that there is intracultural variation with respect to the terms that some fishers use (see Chapter 3). In most cases where this variation exists, when a Discovery Bay fisher is asked if he knows the alternate term, he usually responds, "Ya mon, some call it dat."

Second, the folk genera *parrotfish* also reflects some intermediate structuring of the folk species included in the category. Some, but not all, distinguish a subcategory of *parrotfish* they refer to as *kwab*. These fishers say that *kwab* generally have a broader face and do not have highly contrastive coloration–they are mottled or basically the same color all over. Some other fishers say that *kwab* is merely another term used for *parrotfish*. Determining the folk rank to assign to *kwab* for fishers who treat it as a type of *parrotfish* is not straightforward. If we assign *kwab* to the folk specific rank, then taxons such as *pink kwab* will be at the rank of folk variety. This is the simplest, and most appealing solution. Nevertheless, another solution would be to assign *parrotfish* to the rank that Berlin (1992) refers to as intermediate, and assign both *parrotfish* and *kwab* to the generic rank. It is not unusual to have identical names at two different ranks (Berlin 1992; for examples from a coral reef fishery see Chapter 3).

To complicate matters further, one informant included the Labridae in the *parrotfish* category, referring to them as *okra parrot*. Time constraints limited the sample of key informants sufficiently that none of the others interviewed used this system of naming, but those questioned said that some fishers refer to wrasses as *okra parrot*. A subgroup of fishers from Atulayan Bay, the Philippines also included the wrasses in the same category as *parrotfish* (see Chapter 3), suggesting that this type of intracultural variation is relatively common, especially with respect to fish as similar as the Labridae and Scaridae.

It is also significant to note that approximately one-half of the taxa at both the folk specific and varietal levels for *parrotfish* are labeled by primary,

as opposed to secondary names. Secondary names are linguistically complex, with one part indicating the superordinate category. An example of a linguistically complex secondary name for a fish in English is hammerhead shark. An example from the taxonomy of *parrotfish* is *blue parrot*. Sub-folk generic taxa are usually labeled by secondary names. Berlin (1992) notes that when primary names are used to label folk specific taxa, the species involved usually have high cultural importance.

Many of the local names for the *parrotfish* are descriptive of the color or some other characteristic of the visible morphology of the fish. For example, *moontail* or *redbelly*. A less obvious example is *scarld*, which is the local pronunciation of 'scald.' According to local fishers, the light markings on the head of *Scarus coelestinus* look like scars from a scalding burn. Other names reflect knowledge of other salient characteristics of specific types. For example, *Scarus vetula* is variously referred to as *slimy head*, *blownose* and *okra peji*. Both sexes of *Scarus vetula* sporadically produce mucus cocoons at night for protection (Bohlke and Chaplin 1968), resulting in a slimy surface which is reflected in the three alternate terms for the species. For those not familiar with the vegetable okra, it is slimy; hence, wrasses, some of which produce a mucus cocoon like some parrotfish, are also referred to as *okra*, or *slippery okra*. Names such as *sleep on grass* are derived from fishers' beliefs concerning behavior. The name *sammy johnson* was reported to be derived from the name of a fisher who only caught this type of fish. A fisher who referred to both the adult and supermale as *sammy johnson* said this was done because they swim together, indicating knowledge of the species' underwater behavior.

It was noted above that there is some variation between Discovery Bay fishers with respect to names used in the folk taxonomy. One factor influencing variation appears to be type of fishing. For example, a deep water, hook and line fisher did not distinguish between the different types of parrotfish, he simply referred to them all as *parrotfish*. Parrotfish were not part of his catch; hence, he did not need to distinguish the different varieties. Non-fishers also have less complex taxonomies of fish. For example, fishers have distinct names for filefish (*tobaccofish*) and triggerfish (*ol'wife* and *turbot*). Many non-fishers refer to both triggerfish and filefish as *skinfish*, because you have to skin, rather than scale them prior to eating. In American English, the character of the skin of triggerfish and filefish is recognized by the term 'leatherjacket,' which includes both triggerfish and filefish. Other names appear to be geographically restricted in their application, because they are so obviously related to local circumstances. For example, *saint ann's bay*, referring to the scorpionfish, reflects where you go to the hospital if you are stung by one. The closest hospital is located in St. Ann's Bay.

The reader is referred to Appendix I for further details concerning the folk taxonomy of the fishers of Discovery Bay. The brief summary presented above should be sufficient to indicate the extent of knowledge possessed by these fishers. Equally important is the observation that there is intracultural variation in this knowledge. If it is true, as some have argued, that ecological knowledge of users is a factor influencing receptivity to and providing information significant for governance (Wilson et al. 1994; White et al. 1994; Ruddle 1994; Johannes 1981), then it is important to understand the distribution of this knowledge. Quantitative investigations of this type of information are time consuming and difficult to analyze–they do not fit the tight time constraints of 'rapid appraisal.' Nevertheless, only quantitative analysis can discern patterns in variation in terms of their distribution throughout the society. Since we argue here that traditional knowledge influences behavior with respect to natural resources, intracultural variations in this knowledge may be related to variance in the way individuals treat these resources; hence, we need to account for this variation for effective governance.

Perceptions of trends in resource availability. Fishers' perceptions of trends in resource availability and factors influencing these trends are important aspects of their knowledge of the coral reef ecosystem. These perceptions are also related to aspects of governance. In a review of a number of case studies, Pinkerton (1989) found that a perceived crisis in stock depletion on the part of fishers facilitates management efforts. Further, Zerner (1994) points out how incompatibilities between fisher and management entity beliefs concerning factors influencing resource abundance can negatively influence management efforts. In an attempt to understand user perceptions of trends in resource availability and factors influencing these trends, in-depth interviews were conducted with eight fishers. Additionally, research conducted in Discovery Bay in the early 1990s, which included questions bearing on these issues, was reviewed.

The research conducted in the early 1990s indicates that the fishers were already aware of decreases in the availability of fish. Vatcher (1990) asked 18 fishers what types of fishery regulations they thought would be helpful. The responses can be interpreted in terms of their perceptions of factors influencing the decrease in stocks. Seven of the 18 fishers said a sanctuary was needed. It is assumed that the idea of a sanctuary was being proposed by people at the Marine Laboratory in the early 1990s as it was in June 1995. Five said to ban spear fishing, suggesting that they think the spear fishers are responsible for the declines. One or two fishers each suggested closed seasons, gear limits, increased mesh size and limited entry. Supporting the interpretation concerning spear fishers, Van Barneveld (1991:18) writes that there is a

perception among fishers that spear fishers are responsible for declining stocks which is based on the belief that "spear fishing frightens fish; spear men take the 'fine fish' (very small fish) as well as the 'breeders' (larger parrotfish); night spearing is destructive because it takes unfair advantage of sleeping fish; and finally, spearmen are notorious for stealing from pots."

The in-depth interviews conducted in mid-1995 provide some additional beliefs, as well as duplicate some of the earlier perceptions. Perceptions of pollution as a problem was one of the first points mentioned by over one half of the fishers interviewed. They all mentioned pollution from the Kaiser Bauxite plant. They said that you can see the reddish bauxite dust in the water and all around the plant. They also said that some of the bauxite carrying ships drop oil in the bay, and you can see the dead fish afterwards. They also noted that pollution makes the fish go away. One fisher said that the bauxite dust in the water kills the moss and algae that the fish feed on and fills little holes where fry used to live. Several of the fishers concerned with pollution also blamed declining stocks on pollution from the tourist villas, some of which allegedly send raw sewage into the bay.

Over one half of the fishers also blamed declines on spear fishers and other divers, demonstrating continuity in a perception noted by Van Barneveld (1991). These non-spear fishers feel that spear fishers take any size fish, even the very small, and more importantly, "scare the fish away." They feel that the movement of the spear fishers (and one informant also blamed tourist divers and DBML scientists) disturbs traditional daily movement patterns, feeding and resting areas of the fish. The fish, as a result, stay away. Additionally, they note that there are now spear fishers from other areas such as Trelawny Parish, Montego Bay coming to fish in and around Discovery Bay. One elderly hook and line fisher blamed tourists for introducing spear fishing to Discovery Bay.

The blasting of the channel for access to the Kaiser Bauxite pier was perceived by several fishers as destroying areas where the fish used to rest. One elderly fisher said the blasting both killed and frightened fish away; that the catch dropped after the opening of the channel. This same fisher noted that hurricanes killed many fish and disturbed their traditional movement areas (feeding, sleeping, etc.). He noted that after hurricane Gilbert in 1988 the fish continued to decrease and never really came back. In contrast, he noted that a hurricane in the 1940s seemed to increase the catch. According to him, Gilbert killed small fish, blowing them onshore, and hurt the coral. Supporting this perception of hurricane Gilbert as a potential factor,[17] another fisher noted that, "before 1988 there was very good fishing. Since 1988 its been decreasing. Why? The coral reef where the fish used to live and sleep is no longer there. Now sand and moss covers the area. Now the fish have nowhere to hide

when they're small. Bigger fish get them easily."

One fisher said that use of beach seines in the past damaged the stocks; another said that there's too many fishers for the amount of fish; another said that while the fish in the traps have become smaller, the offshore, deep water catches have remained the same. Significantly, only one fisher placed blame on the number of fishers. Also significant, once again we find variability in fishers' perceptions of the fishery, and this type of variation can be related to reactions to management efforts. If the fishers do not believe that certain behaviors negatively impact the status of the fish stocks, they will be unlikely to respond to management efforts attempting to control these behaviors; hence, it is essential to understand the distribution of variation and use it as a basis for designing and targeting appropriate education programs to facilitate management.[18]

GOVERNANCE

The ecology of the coral reefs of Discovery Bay is potentially influenced by national, regional and local acts, ordinances, and/or other official and/or unofficial regulatory measures. These measures, institutions created to implement the measures and local response to governance are briefly summarized in this section.

National governance. Several acts provide for regulation of activities potentially influencing coral reefs and associated flora and fauna in Jamaica. The *Wildlife Protection Act* (20 September 1945) was enacted to protect fish as well as other wildlife from over exploitation (GOJ 1945). In this act 'fish' is defined as "...any creature which lives wholly or mainly in water" (GOJ 1945:3). With respect to 'fish' the following is prohibited by this act: 1) taking of immature fish, 2) use of a) dynamite or other explosives, b) poisons or other noxious material, c) destruction or damaging of any dam, floodgate or sluice, or d) other than authorized traps, 3) pollution of waters, 4) possession of illegally taken 'fish.' The act outlines appointment of enforcement officers (game wardens, fishery inspectors and others), development and enforcement of regulations, as well as penalties for offenses (fines and/or jail). Recently, under this act, a regulation was introduced prohibiting either the harvesting or selling of white or black coral, and the sea turtle and manatee were declared protected species. Today, administration of the act is the responsibility of the Natural Resources Conservation Authority (NRCA).

The *Watershed Protection Act* of 1963 created a Watersheds Protection Commission whose ultimate purpose was to promote the conservation of water

resources (GOJ 1963). In 1991 the NRCA became responsible for administering this act. Areas defined and set aside as watershed areas by ministerial order are subject to regulation by the NRCA as defined in the National Resources Conservation Authority Act of 1991. The act defines regulatory powers as well as penalties (GOJ 1991).

The *Beach Control Act* (1 June 1956) was directed at regulating the use and development of the foreshore (part of the beach between the high and low water mark) and the floor of the sea, including licensing for construction (e.g., piers, boardwalks, etc.) or public or private use and the establishment of protected areas (GOJ 1956). A historically interesting application of this act with respect to establishment of a protected area for Ocho Rios can be found in Appendix II. The act describes enforcement and penalties. In 1991 the NRCA became responsible for administering the Beach Control Act.

The *Fishing Industry Act* (Act 17 of 1975) is an act directed at providing for the regulation of the fishing industry (GOJ 1975). The act prohibits fishing without a license, prohibits operation of an unlicensed fishing vessel, allows for declaration of fish sanctuaries, closed seasons, and regulations, including allowable gear types and fishing methods and other "measures for conservation of fish" (GOJ 1975:13); 'fish' being defined as including "...shellfish, crustaceans and marine or freshwater animal life" (GOJ 1975:1). Subsequent fishing industry regulations (GOJ 1976) prohibited catching or destroying berried lobster, spiny lobster with carapace length less than three inches, "use for the purpose of fishing any fry net, or any shove net, or any length exceeding 3.66 meters (12 feet)" (GOJ 1976:4), use of a beach seine with bunt mesh size less than 1.25 inches (stretched), corner mesh size less than 1.75 inches (stretched), and wing mesh size less than two inches (stretched). These 1976 regulations also specified the required marking (port identification and registration number) of fishing vessels. In 1989, a closed season was declared for spiny lobster from 1 April through 30 June when peak spawning occurs (Van Barneveld 1991). A closed season for conch was introduced in 1994. Regulations specify enforcement and penalties for offenses (fine or jail).

Finally, the *Natural Resources Conservation Authority Act of 1991* assigns to the NRCA all functions previously exercised by the Beach Control Authority, the Watersheds Protection Commission, and the Central Government in relation to the Wildlife Protection Act (GOJ 1991). There is also a mechanism in the act which gives the NRCA say in the modification of other laws concerning the environment. Hence, the Natural Resources Conservation Authority Act potentially consolidates management, conservation and protection of Jamaica's natural resources under one authority.

Crucial NRCA functions are: 1) to take steps necessary to effectively manage the physical environment to ensure conservation, protection, and

proper use of natural resources; 2) to promote public awareness, manage national parks, marine parks, protected areas, public recreation facilities; and 3) to advise the Minister (Ministry of the Environment and Housing) on matters of general policy relating to natural resources. According to the act (GOJ 1991), the NRCA is authorized to:

- -Develop, implement and monitor plans and programs relating to management of the environment, conservation and protection of natural resources
- -Construct buildings and facilities for public recreation
- -Improve national parks and reserves
- -Zone and license businesses for trade in these public parks, etc.
- -Formulate standards and codes for environmental protection
- -Investigate potential offenses and take appropriate action
- -Undertake studies/promote research on techniques to manage pollution and conserve natural resources
- -Conduct seminars and training programs
- -Designate permits required for certain kinds of construction and development

On recommendation of the NRCA, the Minister may declare any area to be an environmental protected area, a marine park, or national park. The Authority can also recommend prescribed areas to the Minister. If an area is prescribed, permits for construction, development, etc. must be obtained from the NRCA. Permits issued by the NRCA are subject to terms and conditions set by the Authority. The Authority can also reject or refuse to grant a permit. If a permit is not issued for an activity the offender can be fined or imprisoned. Defaults on fines can result in imprisonment. The NRCA also has the power to request an environmental impact assessment.

With respect to marine resources, this authority will have to be exercised in view of powers granted to the Fishery Department (Ministry of Agriculture) under the Fisheries Industry Act of 1975. For example, as part of the exercise of the power granted by the NRCA Act, the Minister of Natural Resources decreed the Natural Resources (Montego Bay Marine Park) Order of 1992. To deal with such overlap, the NRCA Act requires these other agencies to not make final decisions regarding such matters until the NRCA has been consulted. Likewise, the NRCA must consult with appropriate agencies or departments of government when considering applications, permits and regulations.

The NRCA is becoming more involved in coastal zone management. A study conducted by the NRCA in 1994 indicated that 121 of the nation's

public beaches are in a "deteriorated condition." Other problems noted in this study include "depletion of marine resources (including coral reefs), pollution of coastal aquifers and waters, unplanned development and illegal settlements, and beach erosion..." (PIJ 1995:15.5). In 1994, the NRCA started work on development of a coastal zone management plan (CZMP). The plan will include assessments of the degradation of the marine environment, identification of land-based sources of pollution, determination of areas of critical coastal erosion and identification of causes of coastal instability. This CZMP will reportedly be guided by a coastal survey to be undertaken by the NRCA with technical assistance from Uppsala University of Sweden (PIJ 1995).

Governance at the local level. Although regulations governing use of coral reef-related resources are published at the national level, a number of local activities and institutions are having or have the potential to have positive impacts on the coral reefs and associated flora and fauna. The DBML of the University of the West Indies has been involved in conservation-oriented outreach programs through The Fishery Improvement Project (FIP), funded by the Canadian International Development Agency (CIDA), as well as attempts to promulgate interest in and develop a sanctuary in shallow waters in a segment of the western part of the bay. The fishers formed an association, which has been instrumental in involving fishers in conservation efforts. Some of these activities have had the moral, as well as financial support of the Kaiser Bauxite Jamaica Company. Several parish-level NGOs have also developed conservation oriented agendas. Basic outlines of these activities are provided below.

Local government. The national government was reported to be in the process of reforming government at the local level. At the present time, there is no official organization below the parish level. There is a body called the St. Ann Parish Council which is supposed to be representative of the towns that compose the parish. Each of the council members represents a district, and these districts usually include a town like Discovery Bay, which is located in the North West District. The council has various types of committee meetings (e.g., planning, property and development committees) which are supposed to make decisions concerning parish land use, etc. One informant stated that the council is not very effective.

The parish council is supposed to do all land use approvals. If the area involved is a prescribed or 'called-in area,' the request for approval has to be referred to the national level. Another exception involves land declared under control of the Urban Development Corporation (UDC). This is a governmental

body that has the mandate to develop areas for various purposes (e.g., tourism on the north coast). According to one informant, the UDC has the power to sell land with planning authority. They review proposals and buyers, and they can approve the proposal along with the land transfer. This same informant said the UDC comes from Kingston and can do things without the approval of the local council.

It also appears that the Ministry of Construction does not need local approval for projects. An informant, actively involved in conservation issues, provided the example of the shifting of the road at Pear Tree Bottom which allegedly had no local level approval. It did not go through the local planning authority, but the informant stated that they were required to post notice of the project in the Post Office and some other locations. This was not done. Currently, this informant was involved with other residents of Runaway Bay in protesting the government's decision to develop a 'sanitary landfill' behind Pear Tree Bottom for garbage from Ocho Rios. Hence, it appears that local government has little influence.

The marine laboratory and the Fishery Improvement Project. The DBML through the FIP has clearly had some positive impact on the thinking and behavior of the fishers in Discovery Bay. Educational programs, using notice boards, slides and video shows are brought to the fishers on the beach and in their meeting areas (Woodley 1994). Van Barneveld (1992), writing on the impacts of the notice boards on knowledge of fishery regulations and the proposed sanctuary, notes that prior to installation of notice boards only 58 percent of fishers were aware of size restrictions on lobster, 21 percent said there were none, 21 percent did not know and only one fisher knew the correct minimum size. After the poster was up for the entire closed season (1 April to June 30) virtually all fishers knew the minimum size as well as closure dates. In response to a question concerning preferred methods for fishery management, 29 percent (the largest percentage) preferred fish sanctuaries.

Another important impact of the FIP is the use of increased mesh size in fish traps (Sary 1995; Woodley 1994; Sary et al. 1991). Scientists at DBML had noted that a major contribution to the overfishing problem in Discovery Bay was the very small mesh size of fish traps, which are the major gear used to harvest fish in Jamaica. The FIP instituted a two-for-one exchange–fishers who brought in a 1" or 1.25" trap in working order would be given enough 1.5" mesh to build two traps. The program removed 91 percent of the 1" traps and 58 percent of the 1.25" traps and replaced them with 1.5" traps (Sary et al. 1991).

In a follow-up interview of one half of the project participants, 80 percent believed that continued use of larger mesh would improve the future fishery.

Ninety-five percent said this would happen if all fishers used larger mesh, and 65 percent said they would only buy larger mesh in the future. When asked why, they responded that small mesh kills too many juvenile fish, very small fish are difficult to sell, the larger mesh pot is lighter and less seaweed grows on it (Sary et al. 1991). Very provisional findings reported in 1991 indicated that larger and non-juvenile fish are being caught in the larger mesh traps, and that while the mean number of fish caught per larger mesh trap declined 27 percent, mean weight of individuals increased by 79 percent and total catch (weight) per trap increased by 37 percent. The authors warned, however, that these changes were possibly due to increased trap size, longer soak times and the high number of snappers caught during the sampling period (Sary et al. 1991).

In 1995, however, Sary writes that post-project evaluation of trap catches conducted immediately after distribution of the larger mesh as well as three years later indicated that both the fishers and the reef fish populations benefitted from the increase in mesh size. Forty-two percent of the traps deployed used the larger-sized mesh, and both the number of fish and the total weight per trap increased. Further, larger and more valuable fish species increased in the catches (Sary 1995); hence, the FIP two-for-one, increased mesh size exchange project appears to have been a success. Its success can also be gauged by the fact that the Alloa Fishermen's Association was successfully selling the larger-sized mesh in June 1995.

The fishers' association and other NGOs. The Alloa Fishermen's Association was formed in 1991 with the requested assistance of the FIP. It was registered as a district branch of the Jamaica Cooperative Union (a supply cooperative) in 1993, and since then has been operating a fishing equipment supply store which sells fishing supplies at a marginally discounted price. Reported membership in June 1995 was 35 members. In June 1995 it was announced that the association just received a grant of over J$ 500,000 from the Canadian High Commission "Green Fund" to build a new building on Old Folly Beach which will house the gear supply store, a gear locker, a kitchen/bathroom and a room for a caretaker.

As noted above, the association's supply store was stocking and selling the recommended mesh size in mid-1995. The organization also acts as a forum for conservation-oriented activities. Some of the notice boards and presentations mentioned above were presented in the association's meeting room. In May 1995, the association sponsored a well-attended meeting where the director of DBML presented tentative plans for the sanctuary proposed for a part of the western side of Discovery Bay. Members discussed, and in general supported the proposal. This organization appears to be a useful center

for development of local involvement in the conservation and management of the resources of Discovery Bay.

Other NGOs in Discovery Bay which may play a role in the future include the Old Folly Progressive Youth Group (an association involved in skill training, provision of a youth meeting place and a summer camp), The Hopwell Park Citizen's Association (residents of a housing development whose current focus is on issues such as care of the development's road and buildings) and the Marcus y Bob Peoples' Complex (a sports association with a playing field). There was also a Tourist Protection Committee, which appeared to be defunct in mid-1995. While these organizations are not now involved in coral reef-related conservation issues, the organizational ability they represent might be useful in future efforts.

There are also several parish-level NGOs involved in conservation issues: 1) the St. Ann Environmental Protection Association (SAEPA); 2) Friends of the Sea; and 3) the St. Ann Chamber of Commerce. The most active, in terms of conservation is SAEPA, which deals with all aspects of environmental protection. SAEPA has several foci, one of which is public education. For example, they sponsor environmental talks at local schools. They also distribute a newsletter two to three times a year. The subject foci of SAEPA's programs are: 1) wildlife protection; 2) waste management; and 3) land use. They held a well-attended, major workshop with training sessions on coastal zone management for sustainable tourism and fisheries in early 1994. The workshop brought together some 70 participants, representing local planning authorities, NGOs, and the private sector and resulted in an excellent set of recommendations (see Appendix III for a copy of the summary and recommendations). Reportedly, there has been little follow-up, but it was reported that as a result of the workshop SAEPA now has a better relationship with the Parish Council, as well as other governmental agencies and NGOs. This improved relationship was reflected in a well-attended June 1995 public forum on preservation of Jamaica's natural heritage co-sponsored by SAEPA and the NRCA. Most of the discussion at this meeting focused on waste disposal for Ocho Rios (the result of uncontrolled growth of tourist activities; see Shaw 1995). Significantly, the head of St. Ann's Chamber of Commerce suggested consolidating environmental groups under one umbrella organization, a move that might result in better coordination of activities.

Friends of the Sea is a more elite-oriented organization which focuses on tourist-related activities. They work with the St. Ann Chamber of Commerce in Ocho Rios, and much of their focus is the town of Ocho Rios, tourism and dive operators. Friends of the Sea caters to the tourists, selling expensive t-shirts, etc. Likewise, the St. Ann Chamber of Commerce is an elite, business-oriented group, but they, as well as Friends of the Sea, know

that tourist activities which support their businesses are related to the health of the environment; hence, both organizations are environmentally conscious, and are somewhat involved in parish-level conservation activities.

Traditional resource management by fishers. There is no evidence that the fishers of Discovery Bay practice any form of traditional management. Line and trap fishers criticize spear fishers by saying that they take the large, breeding stock, but when these same fishers are asked, in another context, if they keep all the fish they hook or trap, they say yes. When describing fish, one trap fisher who was critical of spear fishers for catching breeding stock, described how a certain species of parrotfish spurted eggs when removed from a trap. Interaction with scientists at the DBML has also provided some of the fishers of Discovery Bay with ready-made, conservation-oriented responses to questions that might be misinterpreted as conservation-oriented practices unless the interviewer is wary and follows up with probing questions.[19] As noted above, some fishers are aware of factors influencing fish abundance, but there is a great deal of unexplored intracultural diversity with respect to this issue, and no evidence that the fishers have developed any institutions addressing these management issues. Many are using the larger mesh traps, but the stimulus seems to be as much economic as an expression of a desire to improve the fishery environment.

With respect to traditional use rights, one does not set a trap on top of another person's trap, and one is not supposed to take fish from another fisher's trap (spear fishers are alleged to steal fish from traps). There are, however, no defined territories that limit one's fishing activities. The fishers fish in waters that they can safely and effectively reach, given the limits of their boats. There is no evidence of territoriality practiced by fishers in nearby towns limiting Discovery Bay fishers' area of operation. Likewise, they mention that spear fishers from other areas are now fishing off Discovery Bay, but they take no steps to stop them. When asked, they say anyone can fish anywhere in the sea.

Fisher compliance with governance. Over a period of three weeks in Discovery Bay (May-June 1995), no violation of the closed season on lobster or any other fishing regulation was observed. Fishers questioned said no one takes lobster during the closed season. They followed this with a comment that they would be fined or go to jail, or that it is good for the lobsters–it gives them time to lay eggs. These are expected responses, and the limited time spent in the area (as well as the limited observation power of one individual involved with many other tasks) strongly suggests that if violations occurred,

they would probably be undetected.[20] In 1990, soon after the closed season on spiny lobster was introduced, Espeut and Grant (1990) wrote that market supply dropped during the closure, but fishers still sold lobster openly on the beach and public restaurants still had lobster on the menu. They went on to suggest that such difficulty in prohibiting the catch of a single species during a closed season of 91 days suggests that management will not be easy.

That part of the problem might have been a failure to make all fishers aware of the regulation was suggested by Van Barneveld (1992), who reported that only 58 percent of the fishers she interviewed in Discovery Bay had knowledge of the lobster season prior to her fishers' education program. Van Barneveld (1991), however, writes that there is little enforcement and very low penalties. Even when a violation is reported, it is difficult to prosecute. One informant reported a case where a government inspector, on another mission, observed a pile of fresh lobster in a Discovery Bay villa during the closed lobster season in 1994. He reported the violation, and the maid who bought it and the fisher were charged. The maid pleaded guilty and was fined. The fisher that she identified pleaded not guilty and his case was 'put back.' Its been 'called-up' several times since, but did not come before the court. Each time the maid had to be called as a witness, but the case was not heard because of alleged back-ups in the court system. Finally, few fishers appear to respect the licensing system. Espeut (1992) suggests that this is evidenced by the fact that many never obtain one. Of 193 fishers in his South Coast sample, only 78 percent claimed to ever have one while only 8 percent claimed to have one currently valid. He suggests that enforcement of fishery regulations suffers due to inadequate manpower.

CONCLUSIONS

The coral reefs and fishes of Discovery Bay have been significantly reduced over the past few decades by both a combination of and interaction of human and natural factors (Hughes 1994). Today, there is only limited tourist activity in comparison to other north coast towns like Ocho Rios or Runaway Bay. Most only pass through Discovery Bay on their way to the other, more developed resort towns. Tourism, however, is an important component of the town's economy, and it may grow in the future, placing strain on local infrastructure as has happened in towns like Ocho Rios. Given the problems Ocho Rios is facing today (cf. Shaw 1995) in light of the application of the Beach Control Act in 1966 (see Appendix II), one wonders if regulations to protect Discovery Bay from the potential negative impacts of such development would or could be enforced. Tourism is one of the

factors driving Jamaica's economy today, and the environment frequently suffers as a result of economic forces.

The Kaiser Bauxite plant, although not a direct user of the coral reef resources of Discovery Bay, uses the coastline and waters to load and transport its product through a channel cut in the reef for that purpose in the 1960s. Fishers also suggest that the bauxite dust pollutes the waters of the bay, although no published evidence supporting that claim was found in the literature. The company, however, is providing both moral and financial support to some conservation and development efforts in the town.

The number of Discovery Bay fishers seems to have remained relatively constant for the past five years. It is evident, however, that closures in other areas (e.g., the marine park in Montego Bay) have resulted in non-local fishers exploiting the waters of Discovery Bay. One can speculate that efforts to reduce fishing pressure by limiting entry in Discovery Bay may only shift the efforts elsewhere along the north coast. There is some evidence that there is a tradition of fishing in Jamaica, with some fishers reluctant to leave the occupation.[21] The fishers of Discovery Bay, fortunately, have a growing awareness of the need to protect the resource, thanks to the efforts of the FIP run by the DBML of the University of the West Indies. The educational programs and the increased trap mesh size introduced by the project are a good start in the recovery of the bay's resources. The DBML's involvement in attempts to establish a sanctuary, and their appropriate involvement of the fishing community in this effort will be another significant step in this direction.

Probably the greatest problem facing the resource, however, is the difficulty in enforcement of regulations directed at fishery or environmental protection. As noted above, some observers have suggested that Jamaica has a problem with enforcement at the present time. This difficulty will only increase if regulations are published prior to development of adequate means of enforcement. Such situations result in a scofflaw social environment which places even greater obstacles in the path of effective conservation (see Chapter 3). What little remains of the coral reefs of Discovery Bay and other areas on the north coast of Jamaica will find it a struggle to recover and survive in the best of regulatory environments. The careful work of the DBML FIP in fisher involvement and education and the introduction of more appropriate gear could prove to be a step in the right direction and a model to be followed and built upon. Such steps might result in the appropriate involvement of fishers in the conservation of the resource, taking part of the responsibility off the understaffed government agencies responsible for enforcement. Similar models could be applied in other sectors (e.g., tourism or industry) impacting the health of the coral reef environment of Jamaica.

NOTES

1. There is conflicting information in the literature concerning changes in the size of the fishing industry. Clementson (1992:108) writes that there has been a 55 percent reduction in effort. This figure appears to be derived from a table on page 107 of her report where she lists 2,137 total boats for 1981 and 963 for 1990. But on page 15 of the same report, she says an estimated total of 1,218 boats were actively fishing the sampling areas, of which 260 were interviewed. Clementson's report focuses only on the south coast coral reef fishery, but Espeut (personal communication, 1995) maintains that there has been no reduction, and in fact an increase in the size of this fishery.

2. The Planning Institute of Jamaica (PIJ 1995) reported that the Fishery Division made an effort to register fishing vessels and license fishers in St. Catherines, Clarendon, St. Ann, St. Mary and sections of St. James Parishes. In the parishes listed they licensed 4,451 fishers and 1,006 boats. This was learned in the final few days of field work, and several attempts to obtain this information, by parish, from the Fishery Division by telephone failed.

3. It was assumed that population figures for Discovery Bay could be obtained from the published 1990 population census; hence, no attempt was made to obtain this information while on the north coast. Unfortunately, after returning to Kingston, I was informed at the Statistical Institute of Jamaica Information Service that the detailed statistics for St. Ann Parish had not yet been published. The 1982 population census for St. Ann Parish was not published until 1993 (SIJ 1993). This publication indicated that for census purposes, Discovery Bay includes enumeration districts 4, 61 and 62. On the basis of the mapping of these districts, as presented in the census report, they are basically in line with what I considered approximate boundaries of the town. The population indicated in the census was 1,151, living in a total of 307 dwellings in 1982 (SIJ 1993). This information was used as part of the basis for the estimate included in the chapter.

4. Time would not permit a sample survey of these facilities in Discovery Bay. Distribution of facilities for St. Ann Parish, as a whole, can be used as a general indicator, and is included in Tables A1 and A2.

5. There were no published employment figures available, and given the large number of small businesses in the community, only a survey would

be able to provide reliable information. A survey was impossible given the limited time available.

6. Number of fishers was determined by asking key informants, two or three from each fishing type (e.g., trap, hook and line, net or spear) the number of fishers in their category. The fishers usually recited names (aloud or to themselves) and counted on their fingers. There was almost no variation between the informants. Where variation existed, a mean figure was used. The total of 76, compares favorably with Sary (1995) who reports approximately 75 fishers for Discovery Bay. Vatcher (1990) reports 74 fishers in 1990, suggesting that the number has remained stable over the past five years.

7. In this case, part-time has no precise percentage associated with it. It simply means that many fishers also have some other source of income, be it steady or just occasional.

8. It can be a mistake to place too much reliance on this correlation, although it exists in most economies. In rapidly changing economies, such as Jamaica, the relationship between income and education often deviates in unexpected ways. For example, taxi owner/drivers have much higher incomes than school teachers, whose government wages frequently do not keep up with inflation.

9. Yearly number of births was sufficient in St. Ann Parish (over 3,000) to have confidence in the yearly infant mortality rates.

10. The person responsible for inspecting tourist villas indicated that a significant number never bother to register and get licensed. The number provided in the text is his estimate.

11. Three vessel counts, on different days, were made at each of the two fishing beaches at times when all vessels would likely be on the beach. At one of the landing sites (Top Beach), several of the larger fiberglass vessels were anchored offshore. Since motors were removed from beached vessels, it was impossible to determine exact percentage of motorized vessels. Sary (1995) reports that 32 percent of the vessels owned by trap fishers are motorized.

12. This may be an overestimate. Other informants, when questioned, reported 'many' outsiders spear fishing in the area.

13. Some fishers identify some Priacanthidae species as *moonshine conga* (e.g., the bigeye and the glasseye snapper). This type of intracultural variability is discussed in the section on folk taxonomies.

Table A1. Source of drinking water for St. Ann Parish.

Source of Water	Percent
Indoor tap/ pipe	27.9
Outdoor private tap/ pipe	7.2
Public standpipe	9.4
Well	0.3
River/ lake/ spring	5.5
Rainwater tank	47.9
Other	1.9

Source: PIJ and SIJ (1994)

14. Three spear fishers, three deep water hook and line fishers, and two shallow water hook and line fishers were used as key informants. They were simply asked, "What are the important types of fish you catch?" The ordering of the fish in their responses was interpreted as indicating relative salience; hence, relative importance. The first mentioned being the most important, etc. Mean rankings were used to arrive at the final ordinal ranking used in the report.

15. In folk taxonomies, shark would be at what Berlin et al. (1973) refer to as the generic level. Evidence suggests that this level is learned first by children (Berlin et al. 1973; Stross 1973).

16. Berlin's (1992) extensive comparative work has indicated that most folk taxonomies manifest five (very rarely six) ranks. Continuing with the folk, American English shark example, these ranks are: 1) kingdom (animal); 2) life form (fish); 3) intermediate (no term); 4) generic (shark); 5) specific (hammerhead shark); and 6) varietal (no term).

Table A2. Percent distribution of toilet facility types in St. Ann Parish.

Type of toliet facility	Percent
Water closet with sewer	9.0
Water closet no sewer	37.9
Pit	51.4
Other	1.7
None	0.0

Source: PIJ and SIJ (1994)

17. Hughes (1994) discusses the complex interactions between overfishing of herbivorous fish, the mass mortality of the echinoid *Diadema antillarum* in the early 1980s, hurricanes and algal blooms which can smother, as well as inhibit the recovery of damaged corals.

18. Peter Espeut's (1992, 1994) surveys conducted on the south coast and in Negril, on the west coast of Jamaica, can be used to illustrate the extreme variation that exists. South coast fishers, when asked if it were possible to abuse the sea so that it would produce less, 52 percent said yes, 48 percent, no. This varied from beach to beach with a low of 37 percent to a high of 62 percent saying it was possible. A limited choice (true or false) set of questions concerning factors reducing catch resulted in the distribution in Table A3.

The range column in the above table indicates the range of variation across different fishing beaches. This question was followed with asking if reductions were the fault of the fish or the fishers. Twenty-nine percent said the fish (range 0-61 percent), 58 percent the fishers (range 21-71 percent) and no response from 13 percent (range 5-60 percent). Clearly, there is a wide range of variation in fishers' perceptions of factors influencing the fishery.

19. A brief, recent example can be used to illustrate this problem. While collecting information concerning species and methods in Discovery Bay, I was interviewing an individual fisher recommended by scientists at DBML. They had very positive interaction with this individual, and he was a cooperative, elderly, knowledgeable fisher. He mentioned a species caught in a beach seine, and I asked him why beach seines were no longer used. He said the fishers no longer used them because they knew that they took everything, small fish and shellfish, harming the resource. An interviewer with little time and the 'politically correct' perception of the traditional fisher as a conservationist would have probably recorded this gemstone of information and written it in a report (hopefully noting that it was obtained from one, highly recommended fisher, who had a lot of contact with the marine laboratory personnel). The present author, a skeptic, both with regard to the 'fisher as conservationist' and the representativeness of a fisher who has had extensive contact with marine scientists, and comes highly recommended, however, continued to probe concerning other possible reasons for the end of beach seining. After a bit of probing, the fisher noted that there was an economic reason. The owners of beach seines used to be 'rich men' who hired labor to set and pull the net. He said that the fish caught today are so few and small, and worth so little that fishers would no longer hire on as labor for the small amount of income they would receive; hence, the demise of the

beach seine. This explanation made sense, but interviews with more fishers (ones not recommended by anyone) provided an additional, and more compelling factor. The dredging for and construction of a harbor for the giant vessels that haul bauxite from the local bauxite processing plant deposited scraps of metal and cable on the bottom of the bay that snagged the beach seines in traditional seining areas; hence, another, more compelling reason for the demise of the beach seine fishery in the bay. No one else said anything that could be interpreted as a 'conservation ethic' although I probably could have stimulated such a response if I asked a question such as "I've heard that fishers quit using the beach seine because it kills the little fish and shellfish, hurting the resource. Is that true?" The author has actually heard investigators use such leading, hence misleading questions!

Table A3. Distribution of fishers' beliefs concerning factors reducing catches.

Reason	Percent	Range %
Weather change	79	71-91
Thieves	73	53-91
Sea pollution	73	37-100
Smart fish	70	40-90
Killing of young fish	69	62-100
Small mesh net	40	24-80
Many sharks	28	20-38
Many fishers	27	5-60
Small mesh pots	26	16-60
Too many pots	10	0-60

Derived from Espeut (1992)

20. It is obvious, but often forgotten, that fishers' activities are difficult to observe. They take place at sea (for the most part), and landings can be made at many places along the coast. Further, illegal catches can be hidden in sacks and carried off the boat along with innocent sacks filled with gear, spare clothing, fish for home consumption, etc. that almost all fishers carry.

21. For example, Espeut (1992) writes that although the fishers he interviewed on the south coast of Jamaica like fishing, some 41 percent said they would change occupation if a good alternative were available. This varied from port to port, with a low of 20 percent and a high of 60 percent saying they would switch from fishing. However, only 29 percent wanted their children to become fishers. This also varied from almost three quarters at Port Morant to only 18 percent at Greenwich Farm. This wide range of

inter-community (and as the percentages suggest, intra-community) variability suggests that additional research on this topic is needed to anticipate fishers reactions to being forced out of the fishery by some sort of regulatory measures.

APPENDIX I TO CHAPTER 4

FOLK TAXONOMY

fish [fish]

ajargo Diodontidae *Diodon holocanthus* balloonfish
ajargo Diodontidae *D. Hystrix* porcupinefish
angelfish Pomacanthidae *Holacanthus bermudensi* blue angel
angelfish Pomacanthidae *H. Ciliarsis* queen angel
angelfish Pomacanthidae *Pomacanthus arcuatus* gray angelfish
angelfish Pomacanthidae *Pomacanthus paru* french angelfish
bad lucks Serranidae *Hypoplectrus aberrans* yellow-belly hamlet
bad lucks Serranidae *H. guttavarius* shy hamlet
bad lucks Serranidae *H. indigo* indigo hamlet
bad lucks Serranidae *H. puella* barred hamlet
bad lucks Serranidae *H. unicolor* butter hamlet
bad lucks Serranidae *H. sp.* masked hamlet
bad lucks Serranidae *H. nigricans* black hamlet
bad lucks Serranidae *H. gemma* blue hamlet
balarton /balatan/ Priacanthidae *Priacanthus arenatus* bigeye
balarton Priacanthidae *Priacanthus cruentatus* glasseye snapper
banana grunt Pomadasyidae *Haemulon chrysargyreum, H. striatum* smallmouth and striped grunt
banana grunt Pomadasyidae *Haemulon flavolineatum* french grunt
barra Sphyraenidae *Sphyraena barracuda* barracuda
barracuda waitin boy Labridae *Clepticus parrai* creole wrasse
black doctorfish Acanthuridae *Acanthurus chirugus* doctorfish
blackjack Carangidae *Caranx ruber* [turns black when caught] bar jack
black parrot Scaridae *Sparisome aurofrenatum* [adult] redband parrotfish
black thicklip Pomadasyidae *Anisotremus surinamensis* black margate
black snapper Serranidae *Hypoplectrus nigricans* black hamlet
blacktail Pomadasyidae *Haemulon carbonarium* caesar grunt
blisterside Scaridae *Sparisoma aurofrenatum* [supermale] redband parrotfish

blisterside Scaridae *Sparisoma aurofrenatum* redband parrotfish
blisterside Scaridae *Sparisoma chrysopterum* redtail parrotfish
blownose Scaridae *Scarus vetula* [adult, head slimy, needs its nose blown] queen parrotfish
blue doctor Acanthuridae *Acanthurus coeruleus* blue tang
blue girl Labridae *Clepticus parrai* creole wrasse
blue kwab Scaridae *Scarus coeruleus* blue parrotfish
blue mah Labridae *Thalassoma bifasciatum* [supermale and phase between adult and supermale] bluehead wrasse
blueman Scaridae *Scarus coeruleus* blue parrotfish
blueman Scaridae *Scarus vetula* [supermale] queen parrotfish
blue parrot Scaridae *Scarus vetula* [supermale] queen parrotfish
blue parrot Scaridae *Scarus coeruleus* [supermale] blue parrotfish
blue rainbow Scaridae *Scarus guacamaia* rainbow parrotfish
bluestripe jack Carangidae *Caranx crysos* blue runner
bonefin Serranidae *Paranthias furcifer* creolefish
bonefish Abulidae *Albula vulpes* bonefish
butterbun Chaetodontidae *Chaetodon capistratus* four-eye butterflyfish
butterbun Chaetodontidae *C. aculeatus* longsnout butterflyfish
butterbun Chaetodontidae *C. ocellatus* spotfin butterflyfish
butterbun Chaetodontidae *C. sedentarius* reef butterflyfish
butterbun Chaetodontidae *C. striatus* banded butterflyfish
butterfish Serranidae *Epinephelus adscensionis* graysby
butterfish Serranidae *E. fulvus* coney
butterfly fish Ephippidae *Chaetodipterus faber* atlantic spadefish
cabali Carangidae *Caranx latus* horse-eye jack
cabali Carangidae *C. hippos* crevalle jack
cabali Carangidae *C. lugubris* black jack
cabalo Carangidae *C. hippos* crevalle jack
cabio Rachycentridae *Rachycentron canadum* cobia
chinaman Holocentridae *Myripristes jacobus* blackbar soldierfish
chub Kyphosidae *Kyphosus sectarix* bermuda chub
conga tony Holocentridae *Holocentrus coruscus* reef squirrelfish
conga tony Holocentridae *Holocentrus sp.* squirrelfish
coshubba /corn sugar Pomacanthidae *Holacanthus tricolor* rock beauty
corn sugar Pomacanthidae *Holacanthus bermudensis* blue angelfish
day grouper Serranidae *Epinephelus striatus* nassau grouper
deady Serranidae *Epinephelus guttatus* red hind
deady Serranidae *E. adscensionis* rock hind
deady Serranidae *E. cruentatus* graysby
deady Serranidae *E. fulvus* coney

doctorfish Acanthuridae *Acanthurus chirugus* doctorfish
doctorfish Acanthuridae *A. bahainus* ocean surgeon
dogteeth snapper Lutjanidae *Lutjanus jocu* dog snapper
dogtooth snapper Lutjanidae *Lutjanus apodus* schoolmaster
drum Sciaenidae *Equetus acuminatus* high-hat
drum Sciaenidae *E. lanceolatus* jacknife fish
drum Sciaenidae *E. punctatus* spotted drum
fifer Aulostomidae *Aulostomus maculatus* trumpetfish
flatjack Carangidae *Selene vomer* lookdown
fus stick grunt Pomadasyidae *Haemulon macrostomum* [from the "first-stick tree" the yellow on the fish is like that of the tree] Spanish grunt
goat mullet Mullidae *Pseudopeneus maculatus* spotted goatfish
godbless Lutjanidae *Lutjanus synagris* lane snapper
goggle-eye Carangidae *Chloroscombus chrysuros* atlantic bumper
goggle-eye Carangidae *Selar crumenopthalmus* bigeye scad
green jack Carangidae *Caranx bartholomei* yellow jack
green jack Carangidae *Caranx crysos* blue runner
grey doctorfish Acanthuridae *Acanthurus bahianus* ocean surgeon
grey snapper Lutjanidae *Lutjanus griseus* gray snapper
grunt Pomadasyidae *Haemulon sp.*
grunt Pomadasyidae *H. parrai* album
grunt Pomadasyidae *H. album* white margate
grunt Pomadasyidae *H. surinamensis* black margate
gutong Scaridae *Sparisome aurofrenatum* [adult] redband parrotfish
gutong Scaridae *Scarus iserti* [adult and juvenile, for some only juvenile] striped parrotfish
hamlet Serranidae *Epinephelus itajara* jewfish
hamlet Serranidae *E. morio* red grouper
hamlet Serranidae *E. striatus* Nassau grouper
hedgehog fish Diodontidae *Diodon holocanthus* balloonfish
hedgehog fish Diodontidae *D. hystrix* porcupinefish
hind /hayn/ Serranidae *Mycteroperca sp.* and *Epineplelus sp.* grouper
hogfish Labridae *Bodianus rufus* spanish hogfish
hogfish Labridae *Bodianus pulchellus* spotfin hogfish
hogfish Labridae *Lachnolaimus maximus* [rare in Discovery Bay area] hogfish
hog snapper Labridae *Bodianus rufus* spanish hogfish
hoseye conga Holocentridae *Holocentrus marianus* longjaw squirrelfish
joblin crow parrot Scaridae *Scarus vetula* [adult, not supermale] queen parrotfish

john moriggle Inermiidae *Emmelichthyops atlanticus* [got name "cause he wriggles about"] bonnetmouth
kwab Scaridae [alternate for parrot] parrotfish
kwab Scaridae *Scarus coeruleus* blue parrotfish
kwab Scaridae *Sparisoma chrysopterum* redtail parrotfish
kwab Scaridae *Sparisoma radians* bucktooth parrotfish
lantern jaw Lutjanidae *Lutjanus mahogoni* mahogany snapper
lawyer /alaya/ Labridae *Halichoeres radiatus* [adult not supermale] puddingwife
leather coat Ephippidae *Chaetodipterus faber* atlantic spade
longjaw Belonidae *Tylosurus crocodilus* houndfish
mackerabel Synodontidae *Synodus saurus* bluestriped lizard
mackerel Scombridae *Scomberomorus regalis* cero
miss darlington Holocentridae *Holocentrus rufus* longspine squirrelfish
miss darlington Holocentridae *H. vexillarius* dusky squirrelfish
miss darlington Holocentridae *H. coruscus* reef squirrelfish
moontail Scaridae *Sparisoma viride* [supermale] stoplight parrotfish
moontail Scaridae *Scarus vetula* [supermale] queen parrotfish
moonshine conga Apogonidae *Apogon sp.* cardinalfish
moonshine conga Priacanthidae *Priacanthus cruentatus* glasseye snapper
moonshine conga Priacanthidae *P. arenatus* bigeye
moonshine snapper Priacanthidae *P. cruentatus* glasseye snapper
moonshine snapper Priacanthidae *P. arenatus* bigeye
mutton snapper Lutjanidae *Lutjanus analis* mutton snapper
niggerfish Balistidae *Melichthys niger* black durgon
nightowl parrot Scaridae *Scarus coelestinus* midnight parrotfish
ocean piper Belonidae *Tylosurus crocodilus* houndfish
okra Labridae *Halichoeres sp.* puddingwife, yellowhead wrasse, slippery dick, yellowcheek wrasse, clown wrasse
okra parrot Labridae *Halichoeres sp.* puddingwife, yellowhead wrasse, slippery dick, yellowcheek wrasse, clown wrasse
okra peji Scaridae *Scarus vetula* [supermale] queen parrotfish
ol'wife Balistidae *Balistes vetula* queen triggerfish
paragrate grunt Pomadasyidae *Anisotremus virginicus* porkfish
parrotfish Scaridae parrotfish
pilotfish Pomacentridae *Abudefduf saxatilis* sergeant major
pilotfish Pomacentridae *A. taurus* night sergeant
pimento grunt Sparidae *Calamus pennatula* pluma
pink kwab Scaridae *Sparisoma chrysopterum* redtail parrotfish
pink parrot Scaridae *Sparisoma chrysopterum* redtail parrotfish

pink parrot Scaridae *Sparisoma radians* bucktooth parrotfish
pogri grunt Sparidae *Calamus calamus* sugereye porgy
pogri grunt Sparidae *C. bajonado* jolthead porgy
pompio Carangidae *Trachinotus falcatus* permit
point nose Carangidae *Caranx ruber* bar jack
pot cover Pomacanthidae *Pomacanthus arcuatus* grey angelfish
pot cover Pomacanthidae angelfish
pot cover Ephippidae *Chaetodipteris faber* Atlantic spadefish
pot snapper Lutjanidae *Lutjanus synagris* lane snapper
queen mullet Mullidae *Mulloidichtys martinicus* yellow goatfish
rainbow Scaridae *Scarus guacamaia* [supermale] rainbow parrotfish
rainbow parrot Scaridae *Sparisoma aurofrenatum* [supermale] redband parrotfish
redbelly Scaridae *Sparisoma viride* [adult and juvenile] stoplight parrotfish
redmouth grunt Pomadasyidae *Haemulon sciurus* bluestriped grunt
redmouth grunt Pomadasyidae *Haemulon plumieri* white grunt
ringtail Acanthuridae *Acanthurus bahianus* ocean surgeon
rockfish Serranidae *Mycteroperca venenosa* yellowfin grouper
rockfish Serranidae *M. bonaci* black grouper
rockfish Serranidae *M. interstitalis* yellowmouth grouper
rockfish Serranidae *M. rubra* comb grouper
rockhind Serranidae *M. venenosa* yellowfin grouper
rockhind Serranidae *M. tigris* tiger grouper
rockhind Serranidae *Epineplelus inermis* marbled grouper
rockhind Serranidae *E. guttatus* red hind
rockhind Serranidae *E. adscensionis* rock hind
roughscale kwob Scaridae *Sparisoma rubripinne* yellowtail parrotfish
roughscale parrot Scaridae *Sparisoma rubripinne* yellowtail parrotfish
roundhead Holocentridae *Myripristes jacobus* blackbar soldierfish
roundhead conga Holocentridae *Myripristes jacobus* blackbar soldierfish
saint ann's bay Scorpaenidae *Scorpaenodes caribbaeus* reef scorpionfish
saint ann's bay Scorpaenidae *Scorpaena plumieri* spotted scorpionfish
sammy johnson Scaridae *Scarus croicensis* [supermale] striped parrotfish
sammy johnson Scaridae *Scarus taeniopterus* [supermale and adult] princess parrotfish
sammy johnson Scaridae *Sparisoma atomarium* [adult and supermale] greenblotch parrotfish
samon Carangidae *Elagatis* bipinnulata rainbow runner
sandfish Serranidae *Serranus tabacarius* tobacco fish

sand grunt Pomadasyidae *Haemulon parrai* sailors choice
satin Lutjanidae [reddish, snapper shaped fish from the deep, not observed]
scarld Scaridae *Scarus coelestinus* midnight parrotfish
scarld Scaridae *Scarus vetula* queen parrotfish
shad Gerreidae *Gerres cinereus* yellowfin mojarra
sheephead Serranidae *Hypoplectrus chlorurus* yellowtail hamlet
sheephead Pomacentridae *Microspathodon chrysurus* yellowtail damsel
silk Lutjanidae [reddish, snapper shaped fish from the deep, not observed]
silvercoat jack Carangidae *Seriola rivoliana* almaco jack
skip jack Carangidae *Caranx ruber* bar jack
sleep on grass Scaridae *Scarus croicensis* [juvenile and adult] striped parrotfish
sleep on grass Scaridae *Sparisoma radians* bucktooth parrotfish
slimey head Scaridae *Scarus vetula* [adult] queen parrotfish
slippery okra Labridae *Halichoeres maculipinna* clown wrasse
slippery okra Labridae *Halichoeres sp.* puddingwife, yellowhead wrasse, slippery dick, yellowcheek wrasse, clown wrasse
snapper Lutjanidae *Lutjanus joco* dog snapper
snapper Lutjanidae *L. griseus* gray snapper
snapper Lutjanidae *L. analis* mutton snapper
snapper Lutjanidae *L. synagris* lane snapper
snit Inermiidae *Inermia vittata* boga
snook Centropomidae *Centropomus undecimalis* snook
snotty parrot Scaridae *Scarus taeniopterus* princess parrotfish
soapfish Grammistidae *Rypticus saponaceus* greater soapfish
solefish Bothidae *Bothus lunatus* peacock flounder
spanish mackerel Carangidae *Elagatis bipinnulata* rainbow runner
stinging grouper Scorpaenidae *Scorpaena plumieri* spotted scorpionfish
streamers jack Carangidae *Trachinotus goodei* palometa
striped grunt Pomadasyidae *Haemulon macrostomum* spanish grunt
switchtail Holocentridae *Holocentrus marianus* longjaw squirrelfish
thicklip grunt Pomadasyidae *Haemulon macrostomum* spanish grunt
thicklip grunt Pomadasyidae *Anisotremus surinamensis* black margate
tikitiki Labridae *Thalassoma bifasciatum* [juvenile and adult] bluehead wrasse
tobaccofish Monacanthidae *Aluterus schoepi* orange filefish
tobaccofish Monacanthidae *A. scriptus* scrawled tilefish
tobaccofish Monacanthidae *Cantherhines pullus* orangespotted file
trunkfish Ostraciidae *Lactophrys bicaudalis* spotted trunkfish
trunkfish Ostraciidae *L. polygonia* honeycomb cowfish

trunkfish Ostraciidae *L. quadricornis* scrawled cowfish
trunkfish Ostraciidae *L. trigonius* trunkfish
trunkfish Ostraciidae *L. triqueter* smooth trunkfish
turbot Balistidae *Balistes capriscus* grey triggerfish
turbot Balistidae *Canthidemis sufflamen* ocean triggerfish
turbot Balistidae *Xanthichthys ringens* sargassum triggerfish
white grunt Pomadasyidae *Haemulon album* margate
white grunt Pomadasyidae *Haemulon plumieri* white grunt
white pogret Pomadasyidae *Haemulon album* margate
whiting Malacanthidae *Malancanthus plumieri* sand tilefish
wireback Carangidae *Trachinotus goodei* palometa
wireback Carangidae *Selene vomer* lookdown
wrenchmen (wenchman) Holocentridae *Holocentrus rufus* squirrelfish
wrenchman Lutjanidae *Lutjanus buccanella* [identified by deep line fisher, another deep line fisher identified the same picture as *satin* and said that the deepwater wrenchman had big eyes like the squirrelfish] blackfin snapper
yellowtail Lutjanidae *Ocyurus chrysurus* yellowtail snapper
yellowtail parrot Scaridae *Sparisoma rubripinne* redfin parrotfish
yellowjack Carangidae *Caranx bartholomaei* yellow jack

Other

conch *Strombus gigas* queen conch
lobster *Panulirus argus* spiney lobster
lobster *P. guttatus* spotted lobster
mother *Scyllarides nodifer* slipper lobster
panatouch *Mithrax spinosissimus* spider crab
sea cat *Octopus vulgaris* octopus
sea egg sea urchin
squid *Sepioteuthis sepioidae* reef squid

Identifications based on Humann (1989) and Robins et al. (1986). The DBML FIP also provided the author with a list of local species captured, along with local names. This list was verified and expanded in the process of the field work conducted in 1995. Users should read the section of the report dealing with folk taxonomies as a means of understanding the complexity and variation manifest in the folk taxonomy presented above.

APPENDIX II TO CHAPTER 4

BEACH CONTROL ACT APPLIED TO OCHO RIOS

The following is a copy of the text of the Beach Control Act as applied to Ocho Rios.

THE BEACH CONTROL ACT

Order
(*under section 7*)
THE BEACH CONTROL (PROTECTED AREA) (OCHO RIOS) ORDER, 1966

(Made by the Minister on the recommendation of the Authority on the 4th day of April, 1966)

1. This Order may be cited as the Beach Control (Protected Area) (Ocho Rios) Order, 1966.

2. That part of the foreshore and of the floor of the sea within the limits set out in the Schedule, together with the water lying on such part of the floor of the sea, is hereby declared to be a protected area for the purposes of the Act and is hereinafter in this Order referred to as the protected area.

3. The following activities shall be prohibited activities in the protected area—

(a) fishing by means of nets, traps or spears, or by means of explosives, poisons, electrical charges or other similar methods;
(b) the use of boats other than boats propelled by wind or oars where such boats are used for purposes other than for the doing of anything which may be lawfully done under the Harbours Act, the Marine Board Act, the Wrecks and Salvage Law, or the Pilotage Act;
(c) the disposal of rubbish or any other waste matter;
(d) water skiing, except in such parts of the protected area as may be

designated by the Authority as water skiing areas;

(e) the dredging or disturbance in any way of the floor of the sea;

(f) the destruction or removal of any treasure or artefact from the floor of the sea.

4. The Authority may, from time to time, appoint persons to undertake the improvement and maintenance of the protected area.

THE BEACH CONTROL (PROTECTED AREA) (OCHOS RIOS) ORDER, 1966

Schedule (Paragraph 2)

Starting at a point on the shoreline situated due north of the Trigonometrical Survey Pillar known as Bently Point, and proceeding due north for a distance of 500 feet; thence due west for a distance of 14,000 feet; thence due south for a distance of 2,200 feet; thence due east to a point situated due north of the north eastern corner of the property known as 'The Point', registered at Volume 933, Folio 450 of the Register Book of Titles; thence due south to the north eastern corner of the corner of the property known as 'The Point', registered at Volume 933, Folio 450 of the Register Book of Titles; thence north-easterly and south-easterly along the shoreline for a distance of 200 feet; thence due north for a distance of 350 feet; thence easterly in a straight line to a point 100 feet due north of the north-eastern corner of the property occupied by the Carib Ocho Rios Hotel, formerly known as Sylvia Lawn; thence in an easterly direction in a straight line to a point 100 feet north of the northern end of the common boundary between the properties known as Sambra and Pedregal on the shoreline, the latter registered at Volume 590, Folio 133 of the Register Book of Titles; thence on a true bearing of N. 78° E. to a point on the shoreline of White River Bay, approximately 450 feet from the centre of the mouth of White River; thence north easterly, north westerly, north easterly and easterly along the shoreline back to the starting point.

APPENDIX III TO CHAPTER 4

RECOMMENDATIONS FROM THE ST. ANN ENVIRONMENTAL PROTECTION ASSOCIATION 1994 TRAINING PROGRAM

The following is a copy of the text of the summary and selected recommendations from the training program.

SUMMARY AND SELECTED RECOMMENDATIONS
from the Training Program in
COASTAL ZONE MANAGEMENT FOR SUSTAINABLE TOURISM AND FISHERIES
Presented by the St. Ann Environment Protection Association
& the St. Ann Parish Council, January 17-28, 1994

Objectives: This program brought together representatives of the local planning authorities, NGOs, and the private sector to jointly examine the planning and management requirements for the sustainable development of Jamaica's coastal areas, using the parish of St. Ann as a starting point. Recommendations from this workshop apply mainly, but not exclusively, to St. Ann. The program outlined the ecological and economic values of coastal ecosystems and the major environmental impacts affecting them, including pollution due to inadequate waste disposal (especially sewage) and the destruction of natural areas by intensive coastal development. Tourism and fisheries needs were emphasized because of their importance to the parish and their dependence on coastal resources. Legal, administrative, and technical aspects of Coastal Zone Management (CZM) were examined, and mechanisms sought to address community development needs and broaden public participation in the planning process.

Participants: A total of 70 persons participated in the program, with an average daily attendance of 19. Twelve NGOs were represented, including environmental NGOs, citizens' associations, and youth groups. Eight

government agencies were represented, with a high level of participation from councillors and staff of the St. Ann Parish Council. The Public Health Department, Town and Country Planning Department, and Natural Resources Conservation Authority provided valuable input. Three media houses, two educational institutions, and the St. Ann Parish Library participated. Four private sector tourism organizations took part, including three resort developers. Important players which unfortunately did not participate were Northeastern Parks and Markets, the Urban Development Corporation, the St. Ann Development Company, and Tourism Action Plan, Limited.

Activities: The training sessions, held at the St. Ann Parish Church Hall in St. Ann's Bay, consisted of brief presentations, including slide shows and videos, followed by discussions. Expertise was provided by participating organizations as well as the VOCA volunteer, Dr. Nelson Marshall. Field trips hosted by developers were made to three major coastal resort developments–Pear Tree Bottom, Drax Hall, and Oracabessa–each with a very different approach to resort development. A visit to the Hofstra Marine Laboratory gave participants an opportunity to view and learn about a variety of living marine species in seawater aquaria.

Outputs: For each component of CZM examined, the discussions resulted in a summary of the current status of that component and a list of participants' recommendations, arranged in a time-frame of immediate, intermediate, and ongoing or long-term actions taken. These outputs were grouped into the following categories: land use and development practices; legal and administrative considerations in CZM; waste management (solid waste, toxic waste, and sewage disposal; water supply and public health issues; coastal water quality; protection of coral reefs; fisheries conservation; protection of shoreline features and biodiversity; attention to public interests in development planning; and environmental awareness. The next page presents a selection of recommendations arising from this training program.

IMMEDIATE NEEDS

- Initiation of Coastal Zone Management plans, area by area, with broad input combining local and national expertise and interests.
- Establishment of conservation areas to protect coastal and marine ecosystems such as wetlands, riparian areas, and coral reefs.
- A moratorium on large-scale coastal developments until zoning for conservation areas is completed.

- Critical housing and infrastructural needs for coastal areas to be addressed immediately by joint Government/Private Sector efforts.
- Increased capacity of resource management agencies (especially the NRCA and the Fisheries Division) and local planning authorities to administer and enforce environmental conservation and development laws.
- Increased interagency coordination and community participation in planning.
- Tourism standards and monitoring systems which take into consideration environmental conservation needs.
- Dump sites secure from leaching and natural hazards, and readily accessible from communities served; improved collection system for solid waste; disposal and collection systems for toxic wastes; depots established in communities for recyclable goods with known markets to better utilize existing collection systems.
- Elimination of absorption pits along the coast of Jamaica; installation of small-scale, environment-friendly sewage treatment systems appropriate for individual households, and secondary treatment coupled with deep-water discharge of effluent for larger developments.
- Public education programs with priority given to appreciation of natural heritage, conservation needs for coastal and marine ecosystems, waste reduction and management, and sustainable land use practices; environmental education programs for the judiciary; NGOs to assist public- and private sector education efforts.
- Register of development applications to be kept by Parish Councils and made available to the public, as prescribed by law.
- Developments of Urban Development Corporation and Ministry of Construction to be subject to approval of local and national planning authorities and NRCA.

INTERMEDIATE NEEDS

- Limits to the size and number of all future coastal resort developments, based on land use needs and tourism carrying capacity.
- Support and incentives for small-scale, community-based tourism enterprises rather than large-scale developments.
- Tax breaks and other incentives for conservation of natural areas.
- Waste- and sewage disposal standards for all sectors (government, industry, residential, etc.), and comprehensive sewage treatment plans and systems for all human settlements.
- Improved system of political representation.

ONGOING/LONG-TERM NEEDS

- A comprehensive land use policy and plan to provide for the sustainable use of Jamaica's natural resources.
- More emphasis on preserving natural features and scenery of coastline in development planning and approval process.
- Property taxes to be reinvested in protected area management.
- Continued monitoring of coastal water quality.
- Increased research, monitoring and management of land-based impacts on marine and coastal environments.
- Long-term restoration programs for damaged coastal areas.
- Reduced rate of population growth.

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