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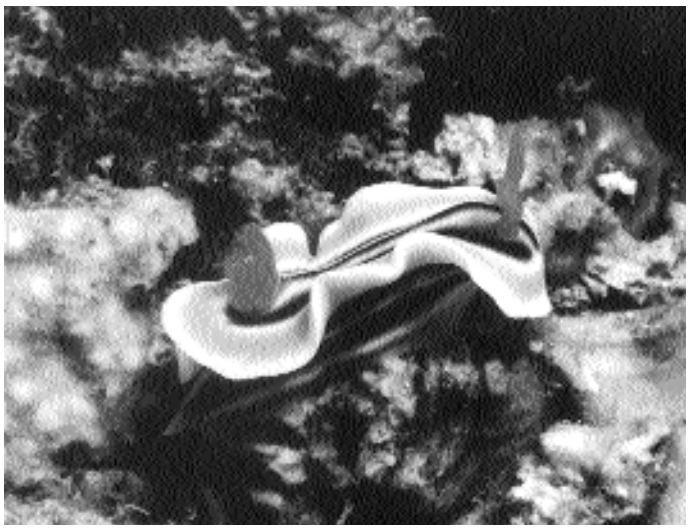

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# 1. Introduction

## 1.1 Marine Protected Areas

Marine protected areas (MPAs) are widely advocated as a means for managing coastal resources (see Salm, et al. 2000). Their use is proliferating around the world, and they are being touted as the most efficient tool for the management of over exploited coastal resources in developing, tropical countries. The Philippines is an extreme example where government policy, international aid, universities, and non-governmental organizations (NGOs) have resulted in the establishment of over 400 MPAs (Crawford, et al. 2000, Parajo, et al. 1999). What is frightening is the fact that while there is clear evidence that MPAs are an effective tool for conserving and improving coastal resources, there are relatively reliable estimates indicating that only some 20 to 25 percent of the over 400 MPAs in the Philippines are successful (Crawford, et al. 2000). This is a disturbing scenario because such a high failure rate can result in rejection of the community-based MPA (CB-MPA) concept just as a similarly high failure rate of fishers' cooperatives resulted in their rejection as a tool for fishery development in the 1970s and 1980s (Pollnac 1988).

In order to forestall the untimely rejection of this important tool for coastal resource management we need to increase the success rate. The best way to do this is to determine factors resulting in observed successes and failures of CB-MPAs. Towards this end, case studies have been written and examined (e.g., Salm, et al. 2000; White, et. al 1994), published literature has been reviewed (e.g., Pollnac 2000) and experts have been convened for focus group discussions (e.g., Crawford, et al. 2000). While such endeavors may give us some insights into factors influencing the success of CB-MPAs, the results are influenced by the fact that information presented is not comparable across the various sites; e.g., we do not know if a certain factor is absent or simply not reported. Additionally, especially with regard to case studies, information is frequently site specific and heavily influenced by the personalities involved in the establishment of the CB-MPA.

Nevertheless, factors uncovered by the foregoing techniques are frequently the result of intimate knowledge of specific projects or sets of projects and are very real for the sites involved. The problem is that the decisionmaker frequently needs information that can be used to apply to a situation where a number of CB-MPAs are planned. In such a case, the need is to develop strategies and tactics that will maximize the chances of success. In other words, the decisionmaker would like to know that if procedures "A", "B" and "C" are carried out, the probability of success is "X". And that if "C" is not carried out, the probability will reduce to "Y" or if "A", "B", "C" and "D" are carried out, the probability of success will increase to "Z". In order to develop this type of information we need an analysis of comparable data collected across a range of sites where probabilities associated with the various factors said to impact success of CB-MPAs can be estimated. Examples of such cross-site studies, at varying levels of precision, include Salafsky, et al. (1999) who identify factors influencing success of enterprise strategies for conservation, World Bank (1999) who identify factors impacting local level management, and Pollnac, et al (1991) who examine

variables influencing success of fishers' cooperatives. What we wish to present here is a modest start in this direction for identifying and evaluating factors influencing the success of CB-MPAs.

### 1.2 Success of Community-Based Marine Protected Areas

There are many aspects of "success", and rather than simply focussing on one, a multi-component approach to success is used in this study. The most obvious measure of success for a CB-MPA involves an improvement in the resource; e.g., measurable increases in the quality and quantity of flora and fauna, including corals where included. Community members' perception of the MPA's impact on the resource is also an important indicator. It is these perceptions that will influence their behavior regarding the CB-MPA. Another indicator of success is the establishment and maintenance of a set of features inherent to a functioning CB-MPA, such as marker buoys, community signboards, a management plan, a management committee, etc. Degree of adherence to the rules associated with the MPA is also an indicator of success. Finally, since a CB-MPA involves empowering community members to manage their own resources, the degree to which this empowerment is realized is a component of success. We contend that a successful CB-MPA will manifest relatively high levels of all five of the aforementioned success indicators.

### 1.3 Factors Influencing Success

The above mentioned focus group meetings of experts (Crawford 2000), literature reviews (Pollnac 2000, 1994), case studies (Salm, et al. 2000), as well as meetings and workshops (among the most recent being WRI 2000) have identified numerous factors that appear to be related to the success of CB-MPAs. Since most of the cited literature is readily available, there is no point listing the factors here, only to repeat them in the methods and analysis sections of the paper. Instead, the general classification of factors will be outlined. For purposes of the analysis presented here, factors influencing success of CB-MPAs are classified into two broad categories: contextual and project. Contextual factors include social, cultural, political, and economic aspects of the lowest levels of political organization (usually the village and the town where it is located) directly responsible for the CB-MPA. Project factors include aspects of project implementation (e.g., strategies and tactics) and post-implementation activities. The paper will examine how these factors individually and in combination impact the various components of success of CB-MPAs.

## 2. Methods

### 2.1 Sample

It was decided to conduct the analysis within one nation as a means of controlling for aspects of national legislation and policies which could impact establishment and sustainability of CB-MPAs. A cross-national study would only further complicate an already complicated analytical problem. The Philippines was selected since the nation has had more experience and a larger number of CB-MPAs than any other country. The CB-MPAs in the Philippines also manifest a wide range of levels of success, ranging from "paper" (existing only in legislation) and non-functional CB-MPAs to those that have achieved worldwide recognition for their achievements (e.g., Apo Island).

To minimize the amount of time and resources spent on travel it was decided to limit the sample to the provinces of Bohol, Leyte, Cebu, and Negros Oriental in the Visayas. The sample is a quota sample including only CB-MPAs which include coral reef area, allow no fishing within the boundary, and were officially recognized by municipal ordinance for at least three years. It was selected to include sites manifesting a range of "success", with a stress on geographic representativeness across the four provinces. The final sample is composed of 14 CB-MPAs located in Bohol, 12 in Leyte, 8 in Cebu and 11 in Negros Oriental (see Figure 1).

### 2.2 Success Measures

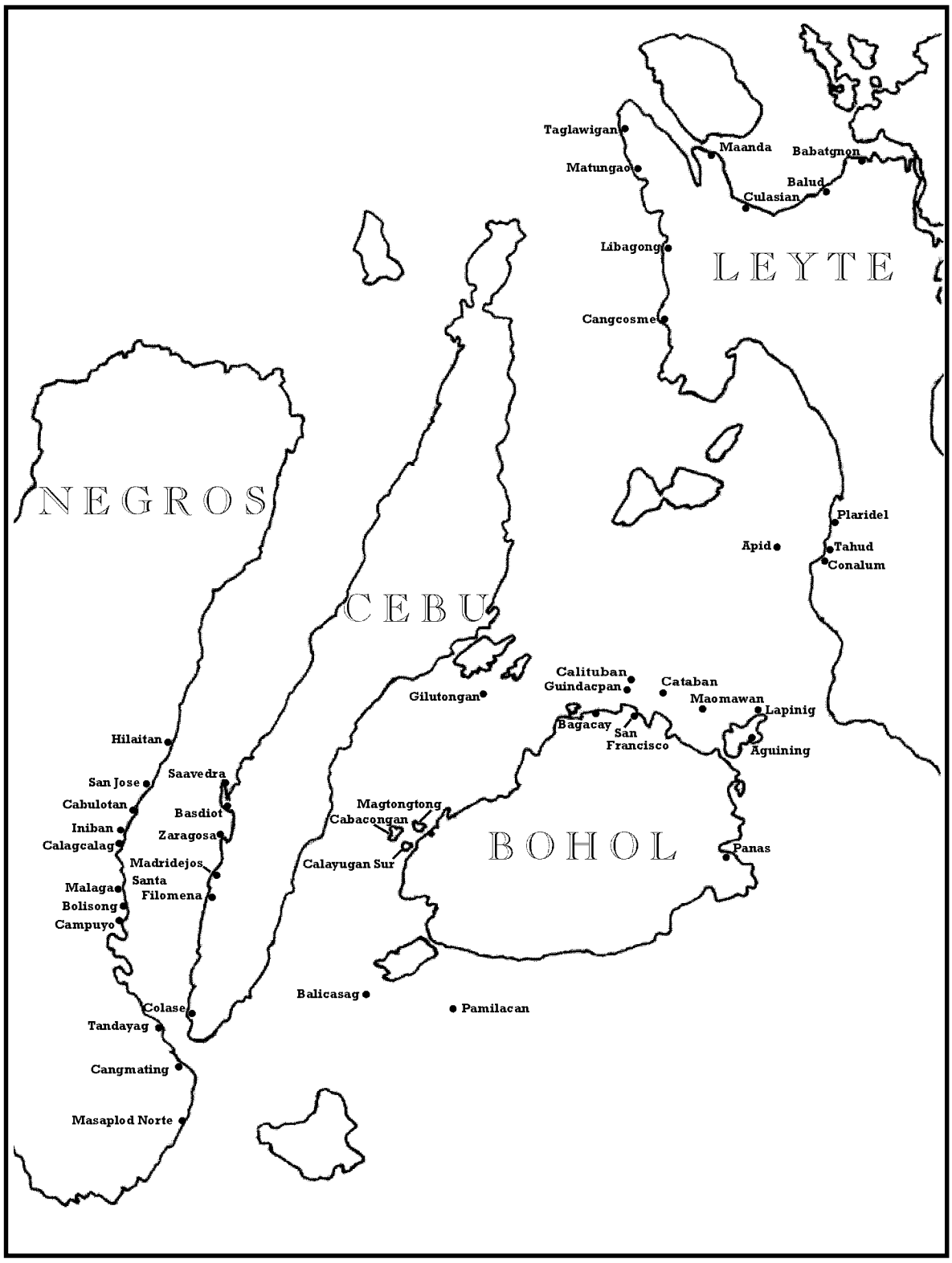
***Difference in coral health***

Since MPAs protecting coral reef area were the focus of this study, one measure of success is the difference in reef quality inside and outside the MPA. Data concerning condition of the coral was determined using a systematic snorkel method.[1] For purposes of this paper difference in mortality index (MI) is the success measure used. This measure was selected over difference in total coral cover because different MPAs would have had different starting points; hence, amount of coral cover would not be a reliable between site measure of MPA effectiveness.[2] MI is calculated by dividing the total amount of dead coral by the sum of total

[1] The systematic snorkel method used required the observer to swim (using a dive mask, snorkel, and fins) over a shallow reef area (1-5 meters deep). The observer had to swim along an imaginary transect line 500 to 1000 meters in total length. The depth of the transect line was maintained by following the contour of the reef. The observer visualized a square meter area on the substrate and, based on a list of parameters, noted the percent cover of each parameter within the imaginary square as seen from the surface. The squares were required to be 50 meters apart (approximated by a predetermined number of fin kicks); hence, ten to twenty 50 meter interval observations were accomplished. This was done both inside and outside (adjacent to) the MPA.

[2] Amounts of live and dead coral were not the only data observed during the transect. Substrate categories included dead substrate (sand and silt, rocks and blocks, coral rubble, white dead standing coral, dead coral with algae), live substrate (hard and soft corals; sea grasses; fleshy, turf, and coralline algae, and sponges). Observed causes of coral damage were noted as well as number of groupers, schools of fish, and large marine life. Presence of garbage and natural debris in the water and along the beach were also noted. These other data will be analyzed in future research.

**Figure 1. Location of community-based marine protected areas surveyed**



amount of live and dead coral. This was done for transect data inside and outside the MPA. The difference in *Coral Health* success measure (referred to hereafter as *Coral Health*) is the figure resulting from subtracting the inside MI from the outside MI. If the MI inside the MPA is greater than the outside MI, *Coral Health* will be negative, suggesting that the MPA is ineffective. The larger the *Coral Health*, the more effective, or "successful" the MPA. The minimum *Coral Health* is -0.21, maximum = 0.67, mean = 0.09, and sd = 0.19.

***Perceptions of resource abundance changes***

Community members' perception of the MPA's impact on the resource is also an important indicator. It is these perceptions that will influence their behavior regarding the CB-MPA. Fishers representing all the different gear types deployed in the community were requested to evaluate the coral, the fish numbers, and the number of fish types in the MPA as well as the numbers of fish adjacent to the MPA. The evaluation was a simple three-point scale—"worse", "the same" or "better" than before the establishment of the MPA. If all of the fishers replied that a specific aspect (e.g., number of fish in the MPA) of the resource improved (e.g., was "better"), the MPA would receive a score of "one" for that aspect. Otherwise, it would receive a score of "zero". The scores for each of the four aspects of the resource were summed, resulting in a scale with a range of from zero to four. This measure is referred to as perceptions of resource abundance changes (referred to hereafter as *Resource Perception*; range = 0 to 4, mean = 2.0, sd = 1.6).

***MPA features***

Another indicator of success is the establishment and maintenance of a set of features inherent to a functioning CB-MPA, such as marker buoys, community signboards, a management plan, a management committee, a file of documents concerning the MPA, a monitoring program, and a guard house. MPA sites were assigned a score of "one" if a specific feature were present and a "zero" if not. These scores were summed creating a MPA features measure (referred to hereafter as *MPA Features*; range = 0 to 7, mean = 3.9, sd = 2.2)

***Degree of adherence to rules***

Degree of adherence to rules associated with the MPA is a further success indicator. This is not easy to measure. Violation rates (if records are kept) are not a good indicator. You may have a relatively high officially recorded violation rate where strict enforcement is practiced and a low or no official violation rate where the enforcement is weak or non-existent. It was therefore decided to have an "expert panel" rank the communities on a scale of from zero to five concerning the degree of adherence to MPA rules. The "expert panel" consisted of the researcher, his research associate, and the three to five experienced field workers who were involved in the data collection process. Following completion of data collection at each site the team assembled (all were involved in the data collection process) and ranked each site in relation to the others. The ranking was based on research team observations, as well as comments made by fishers, members of the MPA committees, officials (e.g., the *barangay* captain, secretary, etc.), and other community members concerning illegal activities in the

MPA. The issue was discussed until a consensus was reached. This measure is referred to as degree of adherence to MPA rules (referred to hereafter as *Community Compliance*; range = 0 to 5, median = 2, mean = 2.2, sd = 1.7).[3]

***Community member empowerment to manage resources***

Finally, since a CB-MPA involves empowering community members to manage their own resources, the degree to which this empowerment is realized is a component of success. This is also difficult to measure. Once again, it was decided to have an "expert panel" rank the communities on a scale of from zero to five concerning the degree of community member empowerment to manage resources. The "expert panel" consisted of the researcher, his research associate, and the three to five experienced field workers who were involved in the data collection process. Following completion of data collection at each site the team assembled (all were involved in the data collection process) and ranked each site in relation to the others. The ranking was based on research team observations, as well as comments made by fishers, members of the MPA committees, officials (e.g., the *barangay* captain, secretary, etc.), and other community members concerning community members perceptions of and involvement in control over their marine resources. The issue was discussed until a consensus was reached. This scale is referred to as community empowerment over marine resources (referred to hereafter as *Community Empowerment*; range = 0 to 5, median = 2, mean = 2.3, sd = 1.8).

***Composite measures***

It is argued here that a successful CB-MPA will manifest relatively high levels of all five of the aforementioned success indicators. Since *Coral Health* (based on differences in coral mortality indices) was missing from four MPAs due to bad weather and the need to move rapidly from site to site, two of the measures do not include *Coral Health* to facilitate inclusion of all the sites in the analysis. The first measure is a simple combination of the four measures, excluding *Coral Health*. This measure is referred to as *Composite Success 1* (range = 0 to 20, mean = 10.4, sd = 5.8). Since some may object to a summation of ordinal and interval scales, another measure was constructed by summing the same four measures dichotomized at sample means or medians, as appropriate. If the site was above the mean (or median) for a specific measure, it was given a score of "one" for that measure. The scores were summed for all four measures, resulting in the second measure of success, *Composite Success 2* (range = 0 to 4, mean = 1.9, sd = 1.5). For the final composite measure, *Coral Health* was dichotomized at "zero". Sites with a *Coral Health* value greater than 0, indicating that coral was healthier in the MPA, were assigned a score of "one", and sites with a value of zero or less were assigned a score of "zero". This score was then added to *Composite Success 2*, resulting in a composite measure including the differences in mortality index. This scale is referred to as *Composite Success 3* (range = 0 to 5, mean = 2.7, sd = 1.6).

[3] Means and standard deviations are supplied for some ordinal variables for informative purposes only.

# 3. Analysis

## 3.1 Introduction

This section provides a brief description of factors alleged to influence the success of CB-MPAs along with an analysis of their relationships with the MPA success measures detailed in the previous section. The factors are classified into two broad categories: contextual and project. The context factors are further subcategorized into three categories: 1) environment and demography, 2) socioeconomic context, and 3) general economic and quality of life. Project variables are subcategorized into the following categories: 1) physical aspects of the MPA and project activities, and 2) aspects of community participation in MPA development.

## 3.2 Contextual Factors and CB-MPA Success

***Environment and demography***

Several aspects of the physical environment and demography have been suggested as factors influencing success of community-based coastal resource management (CBCRM) projects in general or CB-MPAs in particular. Crawford, et al. (2000) suggest geographic size of the village. The direction of this alleged relationship is not clear in their report, but one might suggest that villages with larger geographic areas might be more difficult to govern if the population is dispersed. Alternately, one might assume that larger villages would have more alternative (terrestrial) resources; hence allowing the development of more alternative livelihoods to take the place of resources protected by the MPA. Several researchers have suggested that population size as well as changes in population size influence CBCRM projects (Crawford 2000; Novaczek and Harkes 1998; McGoodwin 1994). Small populations seem easier to organize and rapid increases in population can lead to disorganization and conflict. Distance of the village from the municipal center and /or location on a small offshore island might influence the ability of the municipal government to provide support—government support considered important by Crawford, et al. (2000). Finally, a perceived crisis with respect to coastal resources is alleged to positively influence development of community participation in management (Pinkerton 1989a,b). Fishers representative of all gear types used were asked to evaluate local coral reef condition and the condition of the fish stocks as either good, moderate or poor prior to establishment of the MPA. If a majority of the fishers reported poor, the resource was coded as being in a state of crisis at that time. Correlations between these variables and the measures of components of success and the composite success measures can be found in Tables 1 and 2.

Focusing only on components statistically significantly ($p < 0.05$) related to components of CB-MPA success we find that larger villages (both in terms of area and population) score lower on the degree of adherence to rules measure (*Community Compliance*). Communities with larger populations also score lower on perceptions of resource abundance changes (*Resource Perception*) and community empowerment (*Community Empowerment*). Being located on a small island and perceptions of a crisis in fish abundance has a positive impact on the degree of adherence to rules measure (*Community Compliance*).

**Table 1. Correlations between environmental and demographic factors and components of CB-MPA success.**

| | Coral Health | Resource Perception | MPA Features | Community Compliance | Community Empowerment |
|---|---|---|---|---|---|
| Village area | -0.188 | -0.102 | 0.034 | -0.318* | -0.289 |
| Municipal distance | 0.008 | 0.198 | -0.125 | -0.016 | -0.005 |
| Village pop.(95) | -0.275 | -0.473** | -0.283 | -0.422** | -0.456** |
| Municipal pop.(95) | 0.032 | -0.066 | -0.046 | -0.168 | -0.170 |
| Village Pop. density (95) | 0.011 | -0.282 | -0.102 | 0.084 | -0.131 |
| Change in pop. density (75-95) | 0.160 | -0.085 | -0.015 | 0.284 | 0.138 |
| Small island | 0.273 | 0.054 | 0.101 | 0.317* | 0.255 |
| Crisis coral reef | 0.030 | 0.204 | 0.170 | 0.247 | 0.246 |
| Crisis fish | 0.068 | 0.146 | 0.310* | 0.316* | 0.216 |

* = P < 0.05  ** = P < 0.01

Finally, perceptions of a crisis in fish abundance also have a positive impact on the MPA features measure (*MPA Features*). Turning to the composite measures of CB-MPA success we find a strong negative correlation with 1995 village population for all three measures. This means that villages with larger populations tend to score lower on the measures. The only other statistically significant correlation is a positive one between perceptions in a crisis in fish abundance and *Composite Success 1*.

**Table 2. Correlations between environmental and demographic factors and composite measures of CB-MPA success.**

| | Composite Success 1 | Composite Success 2 | Composite Success 3 |
|---|---|---|---|
| Village area | -0.197 | -0.205 | -0.213 |
| Municipal distance | 0.001 | -0.024 | -0.002 |
| Village pop.(95) | -0.495*** | -0.531*** | -0.594*** |
| Municipal pop.(95) | -0.136 | -0.139 | -0.134 |
| Village Pop. density (95) | -0.130 | -0.203 | -0.179 |
| Change in pop. density (75-95) | 0.096 | 0.072 | 0.052 |
| Small island | 0.223 | 0.161 | 0.223 |
| Crisis coral reef fish | 0.265 | 0.278 | 0.303 |
| Crisis fish | 0.312* | 0.228 | 0.235 |

* = P < 0.05  *** = P < 0.001

***Socioeconomic context***

Aspects of the social environment have also been implicated in success of CBCRM and CB-MPA projects. Although it would have been desirable to limit this category to strictly social variables, it is sometimes impossible to make a strict division with respect to some variables. For example, occupation has both social and economic components; hence, the category is labeled "socioeconomic" to reflect this fact. Socioeconomic and cultural homogeneity have been identified as factors contributing to the success of CBCRM and CB-MPA projects (Pollnac 2000, Crawford, et al. 2000, White, et al. 1994, Doulman 1993, Jentoft 1989, Pinkerton 1989b). This is probably due to the fact that it is easier to achieve consensus with respect to project activities where the population is more homogeneous. Socioeconomic and cultural homogeneity indicators are number of occupations and religions in the community, percent Catholics, farmers, and fishers. Number of occupations, percent farmers and percent fishers is also an indicator of another variable associated with CB-MPA and CBCRM project success, occupation structure and degree of dependence on coastal resources (Crawford, et al. 2000, Pollnac 1994, 1984). Relative importance of the reef fishery, rank importance of fishing and farming, and degree of tourism are other indicators. Importance of the reef fishery is a dichotomous variable, with a score of "one" if the reef is the most important

fishery, a "zero" if it is not. The occupations of fishing and farming are ranked in terms of their importance in the village. All occupations were ranked in terms of their relative importance, with a rank of "one" being most important. Degree of tourism is based on an evaluation by the field team. Each site was evaluated on a scale ranging from zero to five, with zero indicating no tourism and five indicating the highest level of tourism observed within the sample.

Communities with a tradition of cooperation and collective action have also been identified as those most likely to effectively respond to CBCRM and CB-MPA projects (Crawford, et al. 2000; Pomeroy, et al. 1997; Jentoft 1989). The measure of this variable is the number of groups indicative of cooperative or collective action that were active at the site sometime during the past 5 years. Some have linked degree of democracy or authoritarianism to CBCRM and CB-MPA project success (Crawford, et al. 2000). It seems obvious that community-based projects would be more successful in less authoritarian communities, but it should be noted that Novaczek and Harkes (1998) found that successful local level management systems (*sasi*) in the Moluccas (Indonesia) were likely to be associated with the authoritarian power of a strong local leader. Degree of democracy was measured by asking key informants to rank, on a scale of from one to five, how much input villagers have in the process of decision making in the community. Success of CBCRM and CB-MPA projects has also been linked to stability of local governments (Crawford, et al. 2000). The indicators used for this variable are number of municipal mayors and *barangay* captains in office over the past 15 years. Finally supportive local leadership is said to contribute to the success of CBCRM and CB-MPA projects (Crawford, et al. 2000; White, et al. 1994). These are dichotomous variables based on the *barangay* captain's and the municipal mayor's types of involvement in the project. Correlations between these variables and the measures of components of success and the composite success measures can be found in Tables 3 and 4.

**Table 3. Correlations between socioeconomic factors and components of CB-MPA success.**

| | Coral Health | Resource Perception | MPA Features | Community Compliance | Community Empowerment |
|---|---|---|---|---|---|
| No. of occupations | -0.059 | -0.170 | 0.029 | 0.046 | 0.004 |
| No. of religions | -0.226 | -0.316* | 0.123 | -0.062 | 0.094 |
| Percent Catholic | -0.035 | 0.153 | -0.023 | 0.098 | 0.027 |
| Cooperative Groups | -0.078 | -0.203 | 0.197 | 0.038 | 0.043 |
| Conflict level | 0.032 | 0.222 | 0.198 | 0.036 | -0.001 |
| Municipal stability | -0.034 | 0.037 | -0.202 | -0.059 | -0.185 |
| Village stability | -0.096 | -0.066 | 0.173 | 0.200 | 0.049 |
| Mayor's involvement | -0.015 | -0.037 | -0.174 | -0.037 | -0.121 |
| Capt.'s involvement | 0.225 | 0.097 | 0.221 | 0.252 | 0.290 |
| Level of democracy | 0.112 | 0.252 | 0.170 | 0.401** | 0.442** |
| Percent fishers | 0.224 | -0.077 | -0.342* | -0.064 | -0.174 |
| Fishing rank | -0.246 | -0.081 | -0.185 | -0.350 | -0.348* |
| Percent farmers | -0.185 | 0.086 | 0.270 | 0.025 | -0.043 |
| Farming rank | 0.341* | 0.053 | -0.075 | 0.137 | 0.203 |
| Level of tourism | 0.017 | 0.178 | 0.080 | 0.256 | 0.209 |
| Reef fishery first | 0.165 | 0.187 | -0.132 | 0.214 | 0.144 |

* = P < 0.05 ** = P < 0.01

The results in Tables 3 and 4 indicate that only rank of the occupation of farming is related to *Coral Health*—the more important farming, the lower the *Coral Health* measure. Number of

religions is negatively related to *Resource Perception*, and percent of households involved in fishing is negatively related to *MPA Features*. Level of democratic decision making in the village is positively related to both *Community Compliance* and *Community Empowerment*, as well as being strongly related to all three composite measures. Relative rank of fishing is negatively correlated with *Community Empowerment*, *Composite Success 1* and *Composite Success 3* indicating that the more important fishing in the community, the higher the scores on these three measures.

**Table 4. Correlations between socioeconomic factors and composite measures of CB-MPA success.**

| | Composite Success 1 | Composite Success 2 | Composite Success 3 |
|---|---|---|---|
| No. of occupations | -0.020 | -0.039 | -0.060 |
| No. of religions | -0.028 | -0.014 | -0.051 |
| Percent Catholic | 0.069 | 0.051 | 0.051 |
| Cooperative Groups | 0.043 | -0.062 | -0.081 |
| Conflict level | 0.142 | 0.230 | 0.177 |
| Municipal stability | -0.140 | -0.090 | -0.181 |
| Village stability | 0.119 | 0.082 | 0.040 |
| Mayor's involvement | -0.122 | -0.106 | -0.163 |
| Capt.'s involvement | 0.271 | 0.175 | 0.197 |
| Level of democracy | 0.384** | 0.391** | 0.419** |
| Percent fishers | -0.220 | -0.204 | -0.135 |
| Fishing rank | -0.299* | -0.257 | -0.329* |
| Percent farmers | 0.117 | 0.149 | 0.127 |
| Farming rank | 0.094 | 0.030 | 0.114 |
| Level of tourism | 0.216 | 0.143 | 0.080 |
| Reef fishery first | 0.108 | 0.113 | 0.176 |

* = P < 0.05 ** = P < 0.01

***General development and quality of life***

Level of community development (Crawford, et al. 2000; Poggie and Pollnac 1991; Schwartz, 1986), degree of integration into political and economic system (Crawford, et al. 2000; Doulman 1993), and a "healthy" community (Jentoft, et al. 1998) are all said to be related to success CBCRM and CB-MPA projects. Several measures of community development are used in this research. First, the research team evaluated each community in relation to the others on a scale of from one to five (low to high) following the data collection at each site. The evaluation was based on quality of housing, services, and infrastructure. A second measure is the National Statistics Office's development measure for municipalities based on total product. This measure is a scale ranging from 1 to 5, with one being the highest category.

Degree of integration into economic and political system was divided into four components: market, transportation, communication, and political. These were evaluated as follows:

1) **Market**: no links = 0, low level of links (some specialty products (e.g., dried shark fin) are collected by a few buyers who occasionally visit the community) = 1, medium level of links (limited amounts of fish are processed (iced, smoked, etc.) and daily shipped by in small quantities, either by public transportation or small, privately owned trucks to nearby urban areas) = 2, high level of links (most of the catch is processed in processing facilities and trucked to urban areas and/or air freighted to more distant areas) = 3.
2) **Transportation**: no links = 0, low level of links (only unimproved roads, seasonally impassable, with no more than a few small public transportation vehicles (public taxis, pickup trucks with seats in the back, etc.) passing through daily) = 1, medium level of links (improved roads, several daily links via vans or small busses to transportation centers with links to the rest of the country) = 2, high level of links (good roads, frequent bus departures for other areas, frequent local transportation) = 3.

3) **Communication**: none = 0, low (no telephones, only telegraph or radio link with other areas) = 1, medium (few telephones, usually only in mayor's office or army post) = 2, high (many telephones, both private and public) = 3.

4) **Political**: none (no politicians at the level of governor or congress visit the area) = 0, low (politicians visit rarely, less than once per year) = 1, medium (politicians visits at least once a year) = 2, high (politicians visits more than once a year) = 3.

Finally, "healthy" community, which we take to mean "quality of life," is measured by an evaluation of child weights. We contend that a community's well being will be rapidly reflected in the nutritional status of its children. This measure is probably closely related to another indicator of quality of life—infant mortality rate. According to Newland (1981:5) "no cold statistic expresses more eloquently the differences between a society of sufficiency and a society of deprivation than the infant mortality rate." The "rapid response" nature and ready availability of classified pre-school child weights at the local level led us to select it as our measure. The evaluation of child weights is based on pre-school weights of children classified as slightly underweight, moderately underweight, and severely underweight. The community health center is responsible for weighing all pre-school children and making these classifications. They record the number overweight, normal, and slightly, moderately, and severely underweight. The measures used in this research are total percent underweight and total percent moderately and severely underweight.

Correlations between these variables and the measures of components of success and the composite success measures can be found in Tables 5 and 6. Focusing only on factors statistically significantly ($p < 0.05$) related to components of CB-MPA success we find that only two are related to any of the measures of success. Level of communication links is negatively related to *Coral Health*, and level of transportation links positively to *MPA Features*.

**Table 5. Correlations between development and quality of life & composite measures of CB-MPA success.**

| | Composite Success 1 | Composite Success 2 | Composite Success 3 |
|---|---|---|---|
| Village development | 0.119 | 0.064 | -0.025 |
| Municip. Development | 0.050 | 0.051 | 0.051 |
| Economic integration | 0.065 | 0.059 | 0.069 |
| Transportation integ. | -0.016 | 0.013 | -0.049 |
| Communication integ. | -0.175 | -0.215 | -0.251 |
| Political integ. | -0.182 | -0.268 | -0.239 |
| Percent underweight | -0.233 | -0.199 | -0.094 |
| % mod/sev. underwgt. | 0.119 | 0.122 | 0.217 |

* = P < 0.05 ** = P < 0.01

**Table 6. Correlations between development and quality of life and components of CB-MPA success.**

| | Coral *Health* | Resource *Perception* | MPA Features | Community Compliance | Community Empowerment |
|---|---|---|---|---|---|
| Village development | -0.225 | -0.027 | 0.005 | 0.173 | 0.238 |
| Municip. Development | -0.009 | 0.111 | -0.052 | 0.092 | 0.042 |
| Economic integration | 0.122 | -0.045 | -0.002 | 0.032 | 0.218 |
| Transportation integ. | -0.234 | -0.242 | 0.298* | -0.172 | -0.039 |
| Communication integ. | -0.375* | -0.173 | -0.086 | -0.202 | -0.125 |
| Political integ. | -0.037 | -0.147 | -0.060 | -0.185 | -0.214 |
| Percent underweight | -0.008 | -0.223 | -0.190 | -0.150 | -0.194 |
| % mod/sev. underwgt. | 0.129 | -0.075 | 0.161 | 0.185 | 0.077 |

* = P < 0.05 ** = P < 0.01

### 3.3 Project Variables

***Physical aspects of the MPA and project activities***
Crawford, et al. (2000) identified a large number of aspects of project activities that allegedly influence success of CB-MPA projects. In this section of the analysis physical aspects of the MPA as well as project activities not focusing on community participation are examined.[4] Physical aspects of the MPA examined include size, distance from coastal dwellings, and visibility from coastal dwellings. These three variables are expected to be related to success through their impact on surveillance and enforcement. Size may also have independent effects on biological aspects of the resource.

Aspects of the project itself include whether or not there was an opening ceremony. Such ceremonies are expected to instill pride in the MPA on the part of the village. Another variable is the existence of external advice on MPA establishment and operation. Advice is expected to enhance the possibilities of success. This variable is a dichotomy—present or absent.[5] The location of the advising organization (government, university, NGO, etc.) is also alleged to impact success. Timely advice is facilitated if the organization is nearby. Sites are categorized according to nearness of the advising organization (1 = in municipality, 2 = both within and outside the municipality, 3 = outside the municipality), and the categories form an ordinal scale. Location, of course, influences the ability of community members to visit the organization when they need advice. Whether or not the community could obtain advice at the organization is coded as a dichotomy.

Cross visits to successful MPAs have been cited as a factor enhancing chances of success. This variable is also coded as a dichotomy—whether or not a cross visit was made. Some have suggested that the existence of other coastal resource management projects in the community can facilitate success. This variable is also dichotomous. Many rural communities have multiple problems, and addressing some of those not related to MPAs might influence community involvement with the MPA. Hence, it was determined whether or not some non-MPA issues were addressed by the MPA project at an early stage in the project.

The establishment of an MPA removes some of the resource from harvesting by the community. It has been argued that this should be replaced by some sort of alternative or supplemental income generating activities. These activities are sometimes not successful, so percent successful is the measure used in this research.[6] The early identification of a core group or organization for leadership in the MPA project has also been cited as leading to success (White, et al. 1994). This variable is a dichotomy.

[4] Some of the variables (e.g., early formation of core group) involve community participation. They are included in this section of the analysis, however, because the focus of the variable is early group formation.
[5] Type of organization was determined, but it is not analyzed in this paper.
[6] Type of activity was also determined, but it is not analyzed here.

Many individuals have argued that it is necessary to have a live-in expert (extension worker) to help the community implement and monitor CBCRM projects (Agbayani and Siar 1994; Alcala and Vande Vusse 1994). Presence or absence of such an expert was coded as a dichotomy.[7] Visits to the MPA by government officials are another factor that instills community pride in the project. These types of visits are coded as a dichotomy. It is widely accepted that training is a necessary component to any type of development or conservation project, and the establishment of a CB-MPA is no exception (White, et al. 1994). Types of training included in the project were determined, but only the number of training types is included as a variable in this analysis.

Finally, inputs (financial or material) are essential to project success. Carrying out surveillance, constructing guardhouses, installing marker buoys, etc. have costs. Several aspects of providing for these costs were evaluated. The provision and adequacy of financial and/or material inputs from the village, municipality, and other sources were evaluated. These variables are also dichotomous—provision or not of financial and/or material inputs and satisfactory or not. Correlations between these variables and the measures of components of success and the composite success measures can be found in Tables 7 and 8.

Focusing only on components statistically significantly ($p < 0.05$) related to CB-MPA success we find that the size of the MPA is significantly related to *Coral Health*. This correlation is suspicious because the largest MPA is more than twice as large as the next largest and more than 20 times as large as more than 50 percent of the sample. It is also a successful MPA; hence, the distribution of size is highly skewed with a successful outlier—a fact that can result in an erroneous correlation.

**Table 7. Correlations between project activities, aspects of the MPA, and components of CB-MPA success.**

| | Coral Health | Resource Perception | MPA Features | Community Compliance | Community Empowerment |
|---|---|---|---|---|---|
| MPA size | 0.459*** | 0.045 | 0.168 | 0.068 | 0.089 |
| MPA distance | 0.172 | -0.163 | -0.268 | -0.172 | -0.147 |
| MPA visible | -0.224 | 0.009 | 0.118 | 0.054 | 0.139 |
| MPA ceremony | 0.051 | 0.074 | 0.548*** | 0.242 | 0.284 |
| External advice | 0.178 | 0.283 | 0.348* | 0.219 | 0.272 |
| Distance to advice org. | -0.067 | -0.035 | 0.079 | -0.006 | 0.007 |
| Advice at organization | 0.198 | 0.250 | 0.548*** | 0.381* | 0.334* |
| Cross visits | -0.135 | -0.082 | 0.432** | 0.133 | 0.279 |
| Other CRMP in village | 0.564*** | 0.129 | 0.111 | 0.242 | 0.132 |
| Non-MPA issues addressed | 0.311* | 0.129 | 0.408** | 0.272 | 0.349* |
| % succ. alternative inc. | 0.206 | 0.243 | 0.565*** | 0.530*** | 0.577*** |
| Core group early | 0.026 | 0.106 | 0.654*** | 0.475** | 0.497** |
| Live-in expert | 0.052 | 0.020 | 0.039 | 0.124 | 0.218 |
| Government visits | 0.143 | 0.042 | 0.456** | 0.389** | 0.417** |
| Initial training number | 0.117 | 0.053 | 0.663*** | 0.296* | 0.365* |
| Municipal input | 0.161 | 0.071 | 0.202 | 0.333* | 0.260 |
| Village input | -0.313* | 0.219 | 0.280 | 0.201 | 0.333* |
| Other input | 0.085 | 0.228 | 0.509*** | 0.290 | 0.356* |
| Municipal input OK | 0.133 | 0.190 | 0.375* | 0.458*** | 0.458** |
| Village input OK | -0.105 | 0.312* | 0.173 | 0.122 | 0.333* |
| Other input OK | 0.131 | -0.035 | 0.383* | 0.181 | 0.220 |

* = p < 0.05  ** = p < 0.01  *** = p < 0.001

[7] Type of expert as well as frequency of contact was determined but not analyzed in this paper.

**Table 8. Correlations between project activities, aspects of the MPA, and composite measures of CB-MPA success.**

| | Composite Success 1 | Composite Success 2 | Composite Success 3 |
|---|---|---|---|
| MPA size | 0.123 | 0.174 | 0.219 |
| MPA distance | -0.238 | -0.209 | -0.182 |
| MPA visible | 0.105 | 0.203 | 0.184 |
| MPA ceremony | 0.380* | 0.402** | 0.378* |
| External advice | 0.352* | 0.281 | 0.313* |
| Distance to advice org. | 0.020 | -0.015 | -0.087 |
| Advice at organization | 0.483** | 0.409** | 0.420** |
| Cross visits | 0.263 | 0.191 | 0.158 |
| Other CRMP in village | 0.186 | 0.144 | 0.300 |
| Non-MPA issues addressed | 0.372* | 0.262 | 0.311* |
| % succ. alternative inc. | 0.606*** | 0.569*** | 0.633*** |
| Core group early | 0.562*** | 0.515*** | 0.475** |
| Live-in expert | 0.123 | 0.032 | 0.059 |
| Government visits | 0.422** | 0.428** | 0.441** |
| Initial training number | 0.458** | 0.385** | 0.382* |
| Municipal input | 0.270 | 0.274 | 0.305* |
| Village input | 0.324* | 0.282 | 0.278 |
| Other input | 0.444** | 0.359* | 0.335* |
| Municipal input OK | 0.464** | 0.463** | 0.501** |
| Village input OK | 0.287 | 0.280 | 0.305* |
| Other input OK | 0.253 | 0.181 | 0.228 |

* = p < 0.05  ** = p < 0.01  *** = p < 0.001

An opening ceremony is positively related to *MPA Features* and the three composite success measures. External advice is related to *MPA Features*, *Composite Success 1* and *Composite Success 3*. The opportunity of obtaining advice at the advising organization's office is positively related to three of the components of success (*MPA Features*, *Community Compliance*, *Community Empowerment*) as well as all three composite measures. Having another CRM project in the village is only positively related to *Coral Health*, but addressing non-MPA issues early in the project is positively related to three of the components of success (*Coral Health*, *MPA Features*, *Community Empowerment*) and two of the composite measures (*Composite Success 1*, *Composite Success 3*). Percent of successful alternative income projects, early formation of the core group, visits by government officials, number of initial trainings, and satisfaction with municipal inputs are positively related to three of the components of success (*MPA Features*, *Community Compliance*, *Community Empowerment*) as well as all three composite measures. Municipal input is positively related to *Community Compliance* and *Composite Success 3*. Village input is negatively (!) related to *Coral Health* and positively related to *Community Empowerment* and *Composite Success 1*. Other input (non-municipal and non-village) is positively related to two components of success (*MPA Features*, *Community Empowerment*) and all three composite measures. Satisfaction with village input is positively related to *Resource Perception*, *Community Empowerment* and *Composite Success 3*. Finally satisfaction with other input is positively related to only *MPA Features*.

***Community participation and continuity of activities***

This section of the analysis examines the impacts of community participation and continuity of project activities. Many of the factors alleged to influence success in Crawford, et al. (2000) involve some aspect of local participation in the project. Local level participation in project development and implementation has long been recognized as a factor promoting desired changes (Cernea 1991; Chambers 1983; Morss, et al. 1976; Rogers 1969; ) and CB-CRM projects are no exception to this rule (Pomeroy, et al. 1997; Pomeroy 1994; White et al. 1994). Continued engagement of outside facilitators is also suggested as an important factor (Crawford, et al. 2000). Here we examine the impacts of whether or not the community initiated the MPA (dichotomy), influenced aspects of the MPA such as size and location

(dichotomy), whether or not there were community consultations and if they were formal, informal or both (all dichotomies), the frequency of consultations, whether or not the community had a formal vote at a village assembly on the MPA (dichotomy), and whether or not the community made any contributions (money, material, labor) to the development of the MPA (dichotomy). With respect to continuity of project activities, the number of ongoing trainings and whether or not contact with outside facilitators continued after the development of the MPA were determined. Correlations between these variables and the measures of components of success and the composite success measures can be found in Tables 9 and 10.

**Table 9. Correlations between community participation, continuity of activities and components of CB-MPA success.**

| | Coral Health | Resource Perception | MPA Features | Community Compliance | Community Empowerment |
|---|---|---|---|---|---|
| Community influenced | -0.104 | 0.131 | 0.233 | 0.150 | 0.256 |
| Village initiated | -0.031 | -0.106 | -0.100 | 0.014 | 0.082 |
| Community consultations | 0.161 | 0.234 | 0.554*** | 0.423*** | 0.427** |
| Comm. consult. Formal | 0.116 | 0.071 | 0.428** | 0.313* | 0.348* |
| Comm. consult. Informal | 0.174 | 0.001 | 0.535*** | 0.436** | 0.566*** |
| Consultation frequency | 0.188 | 0.315* | 0.637*** | 0.347* | 0.387** |
| Village vote | 0.062 | 0.359* | 0.385** | 0.317* | 0.243 |
| Comm. Contributions | 0.109 | 0.258 | 0.412** | 0.293 | 0.395** |
| Ongoing trainings No. | 0.100 | -0.053 | 0.602*** | 0.333* | 0.466** |
| Continuing advice | 0.183 | 0.359* | 0.504*** | 0.364* | 0.395** |

* = p < 0.05 ** = p < 0.01 *** = p < 0.001

**Table 10. Correlations between community participation, continuity of activities and composite measures of CB-MPA success.**

| | Composite Success 1 | Composite Success 2 | Composite Success 3 |
|---|---|---|---|
| Community influenced | 0.244 | 0.217 | 0.178 |
| Village initiated | -0.036 | -0.091 | -0.094 |
| Community consultations | 0.522*** | 0.414** | 0.455** |
| Comm. consult. Formal | 0.379* | 0.303* | 0.324* |
| Comm. consult. Informal | 0.505*** | 0.446** | 0.445** |
| Consultation frequency | 0.540*** | 0.482** | 0.466** |
| Village vote | 0.405** | 0.355* | 0.359* |
| Comm. Contributions | 0.429** | 0.408** | 0.403** |
| Ongoing trainings No. | 0.450** | 0.353* | 0.335* |
| Continuing advice | 0.510*** | 0.408** | 0.455** |

* = p < 0.05 ** = p < 0.01 *** = p < 0.001

Overall, the analysis indicates statistically significant positive correlations between most of the community participation and continuity of activities and all the success variables except *Coral Health* and *Resource Perception*. The only exceptions are community influence on MPA characteristics such as size and location and community initiation of the MPA. None of the factors are related to *Coral Health*, and only two are positively related to *Resource Perception* (frequency of community consultations and formal vote at village assembly).

***Relationships between combinations of factors and CB-MPA success***

While the individual correlations between pairs of variables demonstrated relatively strong and statistically significant relationships between many of the factors and the success measures, it is combinations of these factors and their influence on CB-MPA success that reflects the situation we find in the real world. Bivariate relationships are interesting, but it is the combination of variables that can be elucidated by multivariate analyses that are of most interest to the individuals concerned with establishing successful CB-MPAs.

The technique used here to identify combinations of factors that can be used to predict success of CB-MPAs is forward stepwise regression analysis. In the application used here, all independent variables (factors that are said to be related to CB-MPA success) statistically significantly ($p < 0.05$) related to a success measure are intercorrelated with the dependent variable (success measure). The one with the highest correlation (the one that explains the most variance in the success measure) is entered first into the multiple regression equation. Then the effects of the entered variable are controlled, and the variable with the highest partial correlation with the success measure is entered into the equation. The $R^2$ (squared multiple correlation coefficient, which is equal to the amount of variance explained in the success measure) for the two independent variables and the dependent is then calculated. The next step enters the independent variable that has the highest partial correlation with the success measure controlling for variables already entered. This stepwise procedure is continued until

**Table 11. Multiple predictors of components of CB-MPA success.**

***DEPENDENT VARIABLE: Coral Health***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| Village input | -0.284 | -2.645 | 0.012 |
| MPA size | 0.356 | 3.354 | 0.002 |
| Other CRMP in village | 0.462 | 4.339 | <0.001 |
| Non-MPA issues addressed | 0.322 | 3.015 | 0.005 |

$R=0.788$ $R^2=0.621$ Adj. $R^2=0.578$ $F=14.365$ $p < 0.001$ $N=40$

*Results unreliable due to outliers for variable "MPA size"*

***DEPENDENT VARIABLE: Resource Perception***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| 1995 Village population | -0.430 | -3.316 | 0.002 |
| Continuing advice | 0.296 | 2.286 | 0.027 |

$R=0.556$ $R^2=0.310$ Adj. $R^2=0.277$ $F= 9.420$ $p < 0.001$ $N=45$

***DEPENDENT VARIABLE: MPA Features***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| Crisis in fish | 0.194 | 2.400 | 0.021 |
| Initial trainings No. | 0.194 | 1.801 | 0.080 |
| Transportation integration | 0.179 | 2.193 | 0.035 |
| MPA ceremony | 0.215 | 2.447 | 0.019 |
| Non-MPA issues addressed | 0.290 | 3.548 | 0.001 |
| Core group early | 0.456 | 4.412 | <0.001 |

$R=0.881$ $R^2=0.776$ Adj. $R^2=0.740$ $F=21.903$ $p < 0.001$ $N=45$

***DEPENDENT VARIABLE: Community Compliance***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| Fishing rank | -0.250 | -2.215 | 0.033 |
| Level of democracy | 0.296 | 2.587 | 0.013 |
| Pct. successful alt. income projects | 0.395 | 3.407 | 0.002 |
| Municipal input | 0.267 | 2.375 | 0.022 |

$R=0.710$ $R^2=0.504$ Adj. $R^2=0.455$ $F=10.181$ $p < 0.001$ $N=45$

***DEPENDENT VARIABLE: Community Empowerment***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| Level of democracy | 0.243 | 2.324 | 0.025 |
| 1995 Village population | -0.329 | -3.246 | 0.002 |
| Community consultations informal | 0.350 | 3.170 | 0.003 |
| Pct. successful alt. income projects | 0.299 | 2.772 | 0.010 |

$R=0.793$ $R^2=0.628$ Adj. $R^2=0.590$ $F=16.484$ $p < 0.001$ $N=44$

some pre-set criterion is reached. In this case the criterion was that the variable to be entered has a $p < 0.05$. Partial correlations were carefully examined at each step to insure that multicollinearity did not have an effect on the analysis. Following the stepwise procedure, the sets of variables entered were then entered into a multiple regression analysis on their respective dependent variables. This was done because some of the variables used in the stepwise procedure had missing data for some sites. These sites were eliminated in the stepwise analysis. If the variables with the missing data were not entered into the equation, an analysis using only the variables entered would include sites previously excluded in the stepwise procedure. The results of these analyses are in Tables 11 and 12.

Results in Table 11 are quite impressive. Most of the adjusted $R^2$ are in excess of .50 indicating that more than 50 percent of the variance in three of the five components of success can be explained by a combination of the predictor variables. The results in Table 12 are even more impressive. All of the adjusted $R^2$ are in excess of .50. With respect to Table 12, it is interesting to note that most of the same predictor variables are found in all three analyses.

**Table 12. Multiple predictors of composite measures of CB-MPA success.**

***DEPENDENT VARIABLE: Composite Success 1***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| 1995 Village population | -0.342 | -3.627 | 0.001 |
| Continuing advice | 0.297 | 3.045 | 0.004 |
| Level of democracy | 0.297 | 3.146 | 0.003 |
| Pct. successful alt. income projects | 0.301 | 2.906 | 0.006 |
| Crisis in fish | 0.201 | 2.114 | 0.041 |

$R=0.825$ $R^2=0.680$ Adj. $R^2=0.639$ $F=16.573$ $p < 0.001$ $N=45$

***DEPENDENT VARIABLE: Composite Success 2***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| 1995 Village population | -0.392 | -3.730 | 0.001 |
| Continuing advice | 0.222 | 2.064 | 0.046 |
| Level of democracy | 0.277 | 2.677 | 0.011 |
| Pct. successful alt. income projects | 0.325 | 2.872 | 0.007 |

$R=0.769$ $R^2=0.592$ Adj. $R^2=0.551$ $F=14.511$ $p < 0.001$ $N=45$

***DEPENDENT VARIABLE: Composite Success 3***

| INDEPENDENT VARIABLE | STANDARDIZED COEFFICIENT | t | p (2-tail) |
|---|---|---|---|
| 1995 Village population | -0.363 | -3.946 | <0.001 |
| Continuing advice | 0.286 | 3.124 | 0.004 |
| Level of democracy | 0.309 | 3.567 | 0.001 |
| Pct. successful alt. income projects | 0.306 | 3.102 | 0.004 |
| Municipal input | 0.262 | 3.029 | 0.005 |

$R=0.865$ $R^2=0.749$ Adj. $R^2=0.713$ $F=20.840$ $p < 0.001$ $N=41$

## 4. Discussion and Conclusions

### 4.1 Discussion

As a first step in the discussion, it is necessary to provide some examples that will help in understanding the implications of all the preceding, number-filled tables. Correlations tell us about the strength of the relationship between two variables. The test of significance tells us the probability that the observed correlation differs from 0.00, or no relationship. A probability statement, such as "$p < 0.05$", indicates that there is less than one chance in twenty (or 5 percent) that the observed value is significantly different from 0.00, or no relationship. Even if one objects to the use of statistically based probabilistic statements with a quota sample,[8] $p < 0.05$ with a sample between 40 and 45,[9] is achieved only with a correlation ( r) somewhere between 0.30 and 0.32. A correlation of this magnitude indicates that by knowing the value of one of the variables in the pair, we can increase our chances of accurately guessing the other variable by about 9 or 10 percent ($r^2$). It *does not* mean that if one of the variables is present the other will invariably be present. Let us look at an example.

Table 7 indicates that the correlation between the measure of MPA features present (*MPA Features*) and sites where community members had the opportunity to visit the office of the MPA facilitating organization for advice is 0.548 ($p < 0.001$). This relationship can be used to illustrate the foregoing discussion by first noting that if the sample is divided into two groups, sites where the community could obtain advice at the organization and sites where they could not, the mean score on *MPA Features* for the former is 4.56 and for the latter, 1.75 ($t = 3.945$, $p = 0.002$). Hence, knowing that community members could visit the implementing organization's office for advice gives us a greater probability of being correct if we assume that they would score high on the MPA features measure. But this is a probability not a certitude. Look at the distribution in Figure 2. It is clear in Figure 2 that while most of the sites that can obtain advice at the facilitating organization's office score high on the MPA features measure (curve on the right side of Figure 2), there are some that do not. Obviously we would be better off if we could combine our variables in some way to increase our chances of predicting (or achieving) success. That is why the regression analyses were conducted.

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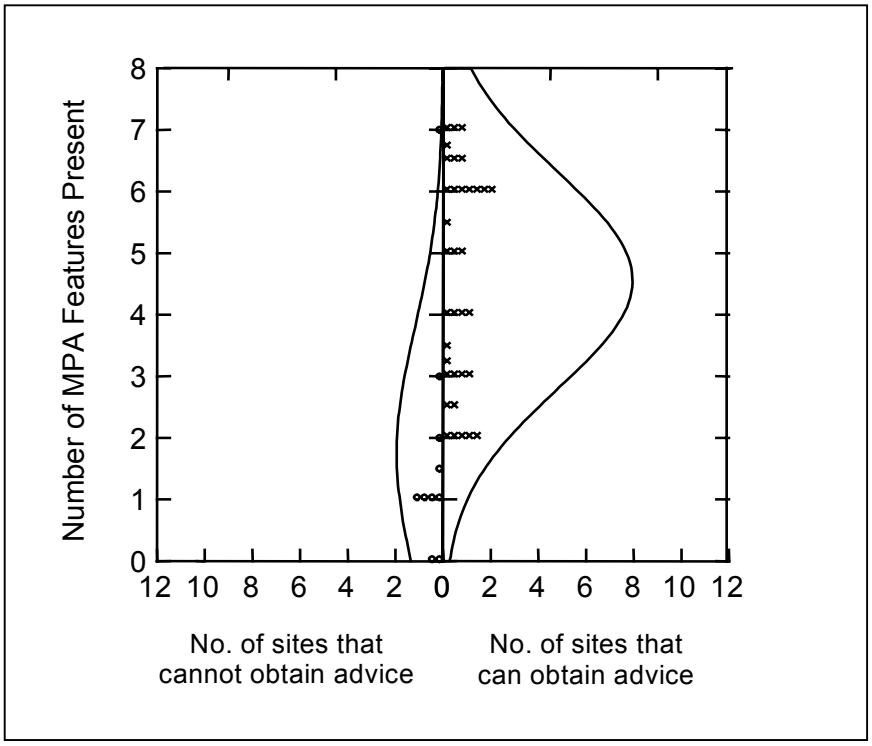
[8] The use of statistical tests on such a sample has been questioned. There is a long history in statistics of conceptualizing such a sample as a sample from the universe of all hypothetically possible data sets collected under the same conditions (see Chein 1976; Thomas 1976; Freund 1960). Almost any current journal in the social and behavioral sciences will contain articles using statistical analyses based on these assumptions. The assumptions, of course, have been questioned (e.g., Hogben 1968; Selvin 1957) as well as supported; thus, while some readers may accept findings based on such samples, others will find them suggestive with the need for testing using a truly random sample. Despite possible reservations concerning the sampling procedure, carefully collected data from such a large sample of CB-MPAs clearly contains information of value to planners, and interrelationships between variables in the data can be used to stimulate further research and theory building.

[9] Due to missing data on some variables, the sample used here manifests this type of variability in size when variables with missing data are part of the specific analysis.

**Figure 2. Distribution of *MPA Features* (number of MPA features present) in sites with and without the opportunity to obtain advice at the organization's office.**




Now what do the regression analyses mean? How can we use the results? Let us look at the results for the combined success measure *Composite Success 1* (Table 12). With today's computational power there are, of course, several ways to select the most important variables out of those used in the analysis (e.g., best subset analysis, which tries all possible combinations of variables and selects those explaining the most variance), but the authors of this paper like stepwise regression. It is intuitively easy to understand, and if used properly (e.g., if partial correlations are examined at each step as a means of identifying problems with multicollinearity), it results in a robust set of predictor variables. The stepwise procedure is illustrated in Table 13.

**Table 13. Stepwise regression analysis, dependent variable: Composite Success 1.**

| VARIABLE ENTERED | $R^2$ | PARTIAL | PROB. | INCREASE IN $R^2$ |
|---|---|---|---|---|
| Pct. successful alt. income projects | 0.37 | | <0.001 | |
| Continuing advice | 0.49 | 0.44 | 0.003 | 0.12 |
| 1995 Village population | 0.59 | -0.44 | 0.004 | 0.10 |
| Level of democracy | 0.67 | 0.44 | 0.004 | 0.08 |
| Crisis in fish | 0.72 | 0.38 | 0.015 | 0.05 |

N=44

Table 13 shows that the stepwise procedure entered percent successful alternative income projects into the equation first. Its R-squared (0.37) was the highest among the 23 variables significantly ($p < 0.05$) correlated with *Composite Success 1*. When this variable was entered, its effects were controlled and partial correlations with *Composite Success 1* were

calculated for the remaining 22 variables. At this stage, only 13 of the independent variables still manifested statistically significant ($p < 0.05$) partial correlations with *Composite Success 1*. "Continuing advice" manifested the highest, so it was entered next in the equation, increasing the R-squared to 0.49, an increase of 0.12 or 12 percent of the variance. When the effects of both entered variables were controlled, "1995 village population" manifested the highest partial correlation, so it was entered next. This procedure was continued until none of the remaining variables manifested a significant partial correlation with *Composite Success 1*. Since one case was missing data on one of the original 23 variables, only 44 cases were used in the stepwise regression analysis resulting in a slightly different R-squared than provided in Table 12, which was based on 45 cases.

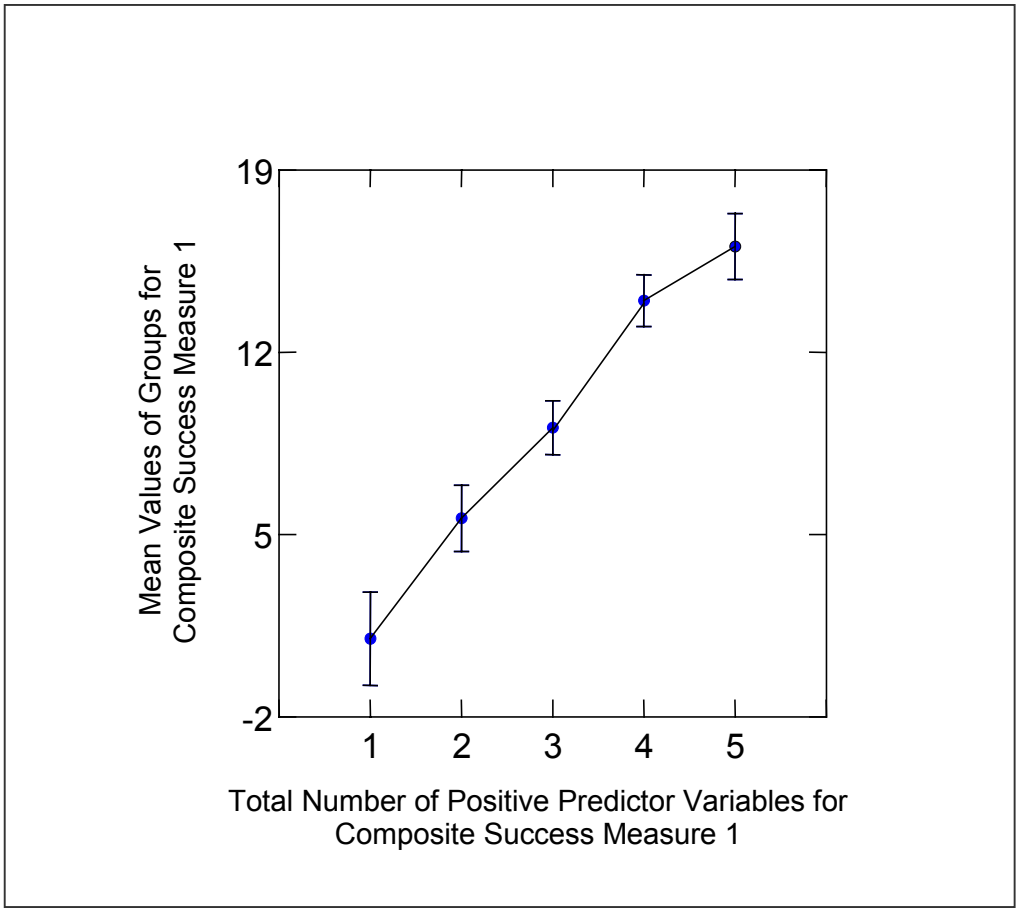
Now let us illustrate the application of the results. The analysis in Table 12 indicates that the adjusted R-squared[10] is 0.64, indicating the five variables together account for about 64 percent of the variance in the composite success measure. The probability that this could have happened by chance alone is less than one in 1000. What does all this mean? It means that if the community in our sample 1) has a relatively small population, 2) a perceived crisis in terms of reduced fish populations before the MPA project, 3) has successful alternative income projects, 4) manifests a relatively high level of community participation in decision making (high on the democracy scale), and 5) has continuing advice from the implementing organization, it is likely to score high on the composite success measure. This can be illustrated by constructing a measure reflecting the presence or absence of each of these characteristics and looking at mean *Composite Success 1* values across the groups manifesting different values on this newly constructed measure. To accomplish this, several new variables are created. Successful alternative income projects, the level of democracy scale, and 1995 village population are dichotomized at the sample medians—sites above the median (below in the case of population) are given a score of one for the variable, the others a score of zero. Continuing advice and perceived crisis in fish are already dichotomous variables. Scores (one or zero) for all five variables are summed, resulting in a scale with a theoretical range of from zero to five for each site in the sample. For analytical purposes we will refer to this variable as *Total Number of Positive Predictor Variables for Composite Success Measure 1*. The actual range is from one to five, reflecting the fact that all sites manifest the "appropriate" value for at least one of the predictor variables. We can now divide the sample into five groups based on their score on this scale—those scoring one, two, etc. This is the total number of positive predictors of success for that group. We can then plot the mean value for the *Composite Success 1* measure for each group. This is accomplished in Figure 3.

It is clear in Figure 3 that as the number of "predictor" variables having a "positive" value at a site increases, so does the score on the composite success measure. Here the term "predictor" variable refers to the five variables entered into the multiple regression for

[10] R-squared is traditionally adjusted when there is more than one predictor variable. This is done to account for the fact that as the number of variables approaches the number of cases there is an increased probability that some linear combination of the variables will account for a very large proportion of the variance; thus, inflating the R-squared. The adjustment is used to reduce the R-squared to a more realistic level. The formula: $\text{Adj. } R^2 = R^2 - ((p-1)/(n-p)) \times (1 - R^2)$, where p is the number of independent variables.

*Composite Success 1*, and a "positive" value on a predictor variable is a one. For example, there are eight sites that have positive values for two of the variables. Their mean score is 5.6. The thirteen sites that have positive values for 4 of the variables have a mean score of 14.0. The bars on either side of the mean in the figure bracket the standard error of the mean, which is equal to the standard deviation divided by the square root of the sample size. More important for our illustration, however, is the range of values on *Composite Success 1* associated with each level. For example, while sites with positive values for five of the predictor variables manifest a range of from 13 to 18.5 on the composite success measure, those with positive values for three manifest a range of from 1.5 to 17--another illustration of the probabilistic nature of the analysis.

**Figure 3. Mean values of groups manifesting various numbers of positive predictor variables for *Composite Success Measure 1***




Another way to illustrate the probabilistic nature of this analysis, as well as illustrate its strength is to classify the sites as "successful" or "unsuccessful". The median score for *Composite Success 1* is 11. Sites with scores above 11 are classified as successful, and those with scores equal to or below 11 as unsuccessful. Looking at sites with positive values for only one or two of the predictor variables, we find no successful sites--100 percent are unsuccessful. Only 67 percent of the sites that have positive values for three of the predictor variables are classified as unsuccessful. This figure drops to 31 percent for those with

positive values for four of the predictor variables, and to zero percent, or no failures for those with positive values for all five. Therefore, decisionmakers should ensure positive values for all five of these variables if they wish to increase their chances of facilitating a successful CB-MPA.

### 4.2 Conclusions

Overall, the analyses indicate that six factors appear to be the most important of those involved in the overall success of the CB-MPAs in our sample:

- Population size (relatively small)
- A perceived a crisis in terms of reduced fish populations before the MPA project is started
- Successful alternative income projects
- A relatively high level of community participation in decision making (high on the democracy scale)
- Continuing advice from the implementing organization
- Inputs from the municipal government

It is important to note that these factors are those identified as most important using step-wise regression, which removes other variables highly correlated with both the success measures and the "most important" variables (see tables 1 to 10). The highly interrelated variables in Table 10--those involving aspects of community participation in MPA projects—are an example of variables that will require further examination. A future analysis will examine these multivariate interrelationships.

Additionally, it is also important to note that some variables widely assumed to be important did not appear so in the analyses presented here. For example, many have suggested that a full-time village facilitator is an important pre-condition to success. As found in Tables 7 and 8, this factor does not have a significant relationship with the success measures used here. The same holds true for the almost ubiquitous belief that MPAs initiated at the village level are more likely to be successful (Tables 9 and 10). Many other variables expected to be related to MPA success also proved to be unrelated in our sample. The significance of findings such as these is that decisionmakers can use them to avoid unnecessary, costly activities in CB-MPA projects. For example, it obviously costs a great deal more to have a full-time facilitator for each village involved in a project. If part-time facilitators achieve the same level of success, as indicated by the analyses presented here, significant savings could be made. For example, one field worker could be assigned to work in several adjacent coastal villages at the same time. Such a practice might have the additional benefit of increasing the rate of replication of CB-MPAs among coastal communities within a region.

The applications of this research for policy and program planning are important. As illustrated in Figure 3, the greater the number of the six predictor variables listed above exhibited at a site, the greater the likelihood of success and therefore, the greater the probability of a positive benefit from the investment made. Hence, planners should try to

ensure that all six predictor variables are exhibited in the communities where a CB-MPA intervention is attempted. If decisionmakers have limited resources and can only work in a few coastal communities at a time, these results point to several criteria to increase the probability of success. It is advisable to select communities that tend to have relatively small populations, where the community perceives a crisis in resource depletion, where there tends to be high levels of participation in community governance, and where local governments are willing to commit inputs into the planning and implementation process. Additionally, planning and implementation strategies in villages selected for CB-MPA interventions should ensure that there are high levels of participation in the process of establishment and management of the CB-MPA, that there are local government resources committed and used, that income generation projects are implemented and sufficient attention given to ensure success. Finally, the agency providing planning and technical assistance to the community should continue to provide services to the community during the planning phase and after the CB-MPA is established. This suggests a co-management approach to CB-MPAs is preferred.

While the six predictors of success mentioned above seem to be the most important factors to combine into a CB-MPA program strategy, the individual factors correlated with success measures in Tables 1-10 should also be considered. Table 14 below summarizes factors (community contextual and project intervention variables) that tended to be most strongly related to the various components of success in the analysis, the possible rationales of why they may influence success, and specific recommendations for program managers and planners. The summary table suggests that there are more project intervention factors important to determining success than contextual factors. For contextual factors, level of community development and quality of life seem to be less important than environmental, demographic and socio-economic factors. For project interventions, the availability of advice, addressing non-MPA related issues including alternative income generation, visits and ceremonies, as well as input from local government, the village and other sources seem to be important characteristics of successful CB-MPAs. With respect to community participation strategies and continuity of activities, almost all of these seem to be important for success, especially for community empowerment, compliance with MPA rules, as well as for establishing and maintaining MPA features. Interestingly, whether the village or an outside organization initiated the CB-MPA, and whether the community influenced the size and location of the CB-MPA or not, do not seem to be important factors determining success.

We have several caveats with respect to applying the present analyses. First, nothing has been said about the factors influencing important predictor variables, such as the success of alternative income projects. We will try to elucidate some of these factors in future analyses of the data. Second, some of the predictor variables seem to be inherent characteristics of a community—possibly the result of historical forces in the area—such as level of democracy. Changing these characteristics, e.g., improving the level of democracy in a community may prove to be a difficult, long-term or impossible task. Perhaps, it would be most efficient to select sites where community members already have substantial input in community affairs. These caveats hold with respect to many of the factors found to be related to success—how do we implement the proximate preconditions to success? Third, one has to agree that the success measures used here actually measure what we mean by "success of a CB-MPA", and

fourth, we do not know if the findings can be generalized beyond the Visayas region of the Philippines. Despite these caveats, the findings should prove to be a useful supplement to the many case studies found in the literature. Application of the findings should improve the present success rate of CB-MPAs. They should also stimulate further research to identify in more detail the factors influencing the success of CB-MPAs, hopefully resulting in an even more improved success rate among these important institutions.

**Table 14. A summary of factors correlated with success measures, the possible rationale and assumptions behind these relationships, and recommendations to program and project managers to increase the probability of CB-MPA program success.**

| Contextual Factors | Rationale/Assumption | Recommendation |
|---|---|---|
| ***Environmental and Demographic*** | | |
| • Village area | • Community compliance with rules of the MPA is easier in smaller geographic areas. | • Select communities with relatively small geographic areas. |
| • Village population | • Smaller populations tend to make community consensus building and compliance easier. Additionally, they may tend to see benefits in terms of increased fish abundance more readily. | • Select communities with relatively small populations. |
| • Small island | • Small islands tend to have less interference from outsiders and tend to be closer knit socially making compliance easier. They also tend to have smaller populations. | • Small island communities are good candidate sites for CB-MPA interventions. |
| • Perception of a crisis in fish abundance | • Communities that perceive a crisis in fisheries may be more willing to take action to reverse such trends and also more willing to erect physical features to enhance compliance. | • Choose communities that are already aware of or concerned about declining fish populations. |
| ***Socio-economic*** | | |
| • Level of democracy | • Communities with a tendency for democratic decision making are more predisposed to developing broad-based consensus and complying with decisions reached through a participatory process. | • Choose communities where there are traditions of participatory and democratic decision making. |
| • Rank of fishing | • The more important the occupation of fishing is to the community, the more interested and committed they may be in attaining fish production benefits from a CB-MPA. | • Select communities that are more dependent on the occupation of fishing as a household productive activity. |
| ***Development and Quality of Life*** | | |
| • General | • Development and quality of life indicators do not tend to greatly affect the success of CB-MPAs. | • CB-MPA interventions are likely to be appropriate for any coastal community regardless of level of development or overall quality of life. This group of factors therefore is not very important for community selection. |

**Table 14. Continued**

| Project Factors | Rationale/Assumption | Recommendation |
|---|---|---|
| ***Project activities and aspects of the MPA*** | | |
| • Core group formed early | • A core community planning group will be influential in developing widespread community support for the CB-MPA and provide important advice to the field worker and associated technical team. | • Identify important formal and informal community leaders as soon as possible and form a core planning group in the early phases of project initiation. |
| • Initial training and cross visits | • Early training helps build community understanding concerning the CB-MPA concept and benefits. Cross visits to successful CB-MPA sites provides convincing and concrete evidence of the benefits of a CB-MPA to the community. | • Start training activities in the early phases of project initiation and include cross visits to other successful CB-MPA sites. |
| • Other CRMP activities in the village | • Other CRM issues can directly impact the effectiveness of a CB-MPA (e.g. bomb fishing) hence these issues must also be addressed in an integrated management framework. | • Implement CB-MPAs as part of a broader CRM initiative in the community if possible. |
| • Non-MPA issues addressed including implementation of successful alternative income activities | • Addressing issues of concern to the community demonstrates commitment by the intervening institution and builds good will and trust. Alternative income generating activities help replace or supplement losses caused by the establishment of the CB-MPA (e.g. loss of fishing grounds, ending easy and profitable bomb fishing). | • Establish CB-MPAs while also addressing other development and livelihood issues of concern to the community. |
| • MPA ceremony and government visits | • The CB-MPA must be formally acknowledged by community leaders and higher levels of government to reward community support and compliance as well as to justify and sanction local enforcement. | • Encourage and arrange for government officials to visit CB-MPA sites. Ensure that a local ceremony is held to formally recognize and designate the CB-MPA. |
| • Municipal, village and other inputs | • Local inputs confirm commitment and support for the CB-MPA. Local resources are necessary for adequate management including maintenance and enforcement. Outside inputs supplement what is typically meager local resources. | • Require local government and village inputs as conditions for starting CB-MPA planning activities. Welcome and accept contributions and inputs from other sources as well. |
| • External advice available to the community and at the office of an outside intervening organization | • Local communities may not have adequate technical capacity to resolves new issues that may arise. Outside scrutiny provides constant reinforcement of successful management and helps to highlight and solve on-gong problem areas. | • Ensure that the community has easy access to advice from the field worker and other technical advisors. Create a welcoming and inviting climate and locate the project office where community members can easily get to and feel free to visit. |

**Table 14. Continued**

| Project Factors | Rationale/Assumption | Recommendation |
|---|---|---|
| ***Community participation and continuity of activities*** | | |
| • Community consultations, frequency and type - formal and informal | • Frequent consultations with community stakeholders develop widespread consensus concerning location and rules governing a CB-MPA. Formal consultations provide opportunities to obtain overall community and leader inputs into the planning process. Informal consultation methods are essential to ensure that disadvantaged and un-empowered community groups also have a voice in the establishment of the CB-MPA. | • Ensure that there are frequent community consultations throughout the planning process. Use formal consultation methods and especially ensure these are well supplemented with informal consultation methods. |
| • Village vote | • A village vote in favor of or to reject the CB-MPA provides legitimacy and authority to the final planning outcome. | • Require a formal village vote approving the location and rules associated with the implementation of the CB-MPA. |
| • Community contributions | • Community contributions demonstrate sincere commitment by the community and also provide an incentive to ensure that the community investment of resources has a positive payback for them. | • Require community contributions for CB-MPA planning and implementation activities: in-kind labor, materials or funds. |
| • Ongoing training | • Community capacity for CB-MPA management is generally quite weak initially, therefore a large investment in community capability building is required over the long-term for the CB-MPA to be successful and sustainable. | • Continue training activities to build community capacity throughout the planning phases as well as after the CB-MPA is established. |
| • Continuing advice | • Community capacity may be limited and therefore access to outside expertise and support to deal with unexpected events that may impact the CB-MPA from time to time may be needed. Periodic outsider visits to CB-MPA sites help reinforce their value among the community and may help stimulate continued implementation activities. | • Provide on-ongoing and periodic advice to the community even after the CB-MPA is established. |

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