Integrating economic, environmental and social issues in an evaluation of Saba Marine Park, N.A., Caribbean Sea

A report to:

Mr. K. Buchan, Manager
Saba Marine Park
Fort Bay
P.O. Box 18
Saba, Netherlands Antilles

Mr. T. van't Hof, Chair
Saba Conservation Foundation
The Bottom, Saba

Executive Council
Government Building
The Bottom, Saba

March 1995

by Leanne Fernandes

Fernandes, Leanne

Integrating economic, environmental and social issues in an evaluation of Saba Marine Park

Printed on recycled paper

Leanne Fernandes
East West Center
EWC Box 1037
1777 EastWest Rd.
Honolulu HI 96848
U.S.A.

Printed by Honblue, Honolulu

Front cover photo by Erik. H. Meesters.

CONTENTS

EXECUTIVE SUMMARY

The people of Saba are concerned that increasing pressure for economic development may pose a threat to their island's unique marine resources. To better manage the ocean environment for the long-term benefit of the community, Saba's decision makers have commissioned studies to provide the comprehensive information needed to make knowledgeable choices. The study reported here examines the multiple objectives of different community groups with regard to management of Saba Marine Park, which encompasses all the inshore waters of the island and is one of the most successful marine parks in the region.

The main research conclusions are:

. the Saban community largely agrees about what should be the most important objectives for park management;

. current park management is achieving valuable ecological, economic, and social objectives; and

. park management would be improved if it
(a) increased communications with the community and
(b) improved public compliance with park rules.

Determining the important objectives

The evaluation of Saba Marine Park management alternatives presented here is based on the opinions and desires of the Saban community. Personal interviews with 48 adults, school surveys of 33 students, and public and small group meetings with about 60 people were conducted to reveal those issues that Saban residents considered most important. In sum, approximately nine percent of the total population of 1200 directly participated in this research. A further set of interviews was also conducted with tourist divers visiting the island.

There was a surprising amount of concurrence among quite different people concerning the objectives that are most important for Saba's marine park. The same main objectives were identified by almost all components of the Saban community, from fishermen to developers:

- achieving ecological sustainability and environmental quality;
- bringing economic benefits to Saba;
- managing the park in a socially acceptable manner and
- providing an international site for learning about marine biology and management using the Saba Marine Park as a model.

Although the last objective was introduced by just one interested party, other people, when queried, considered it relevant for themselves as well.

After the residents identified the park management objectives they believed were most important, the objectives were framed by the researcher into a hierarchy similar in form to a family tree. Major objectives constitute the highest level of the hierarchy, below which sub-objectives were organized. Each sub-objective contributes to the objective at the level above (see Figure 2 of the main text).

Residents varied in the relative importance they attached to the different objectives. Such variation was formally incorporated into the analysis. For example, although some residents considered the social objective far more important than the economic objective, others considered the economic objective paramount. **Most people recognized that ecological and economic objectives of Saba Marine Park are not mutually exclusive, but actually dependent on one another.** Despite these differences, the people of Saba agreed that the overall goal of park management should be "Maintaining the marine resources of Saba for the benefit and enjoyment of people in perpetuity".

Scuba diving is a major tourist industry on Saba. Interviews showed that both the government and people of Saba support continued dive tourism to Saba. A formal survey of 95 divers indicated that Saba Marine Park was an important part of the reason the divers are attracted to Saba. Many also expressed concern about potential over-development on land and over-exploitation of the marine environment. An informal survey of about 20 divers determined that the current diver's fee (US$2 per dive) was gladly paid to support the marine park. These results have economic implications and suggest that **divers who currently support tourism in Saba see maintenance of the island as it is, above and below water, as the most important objective and seem willing to help pay for its achievement**.

Determining management alternatives

With input from the community and decision makers, five alternative management strategies were proposed :

. Saba Marine Park as it currently is (no change);
. Saba Marine Park with more community communication and education activities;
. Saba Marine Park without the current "No fishing" zone;
. Saba Marine Park with greater efforts to assure compliance with existing regulations and to prevent overuse; or
. Saba Marine Park ceasing to exist (as a basis for comparison).

The relative value of each of these management alternative was measured in terms of
(a) the degree that each was thought to achieve the stated Saba Marine Park objectives and
(b) the relative importance different interest groups placed on the main objectives identified above.

The five management alternatives were compared with one another based on how well they achieved the desired objectives. The relative expected success of each management alternative in meeting desired objectives was estimated by the chair of the Saba Conservation Foundation and the manager of the Saba Marine Park. Estimates were made with reference to quantitative or qualitative data that served as yardsticks for the achievement of different objectives. For example, the degree

of success in meeting the objective of marine education for Saba's children was indicated by the number of marine environment lessons taught per year in the schools.

The importance attached to each objective by each stakeholder provided a weighting for each objective. The relative weighting and degree of achievement of an objective determine the contribution of that objective in achieving the overall goal of the marine park.

Establishing future scenarios

There is uncertainty about the future operating conditions for the Saba Marine Park. This uncertainty was incorporated into the analysis by evaluating the management alternatives under different future scenarios that are outside the control of the park. The scenarios explored were:

- the status quo;
- a major oil spill;
- a major increase in tourism and
- major coastal construction.

Analytical method

All the information gathered was analyzed using the Analytic Hierarchy Process, a formal decision analysis technique that uses multiple pairwise comparisons to derive priorities among objectives and, subsequently, among alternative management solutions.

Final evaluation of management alternatives

Results indicate that the Saba Marine Park, even without change, is far more valuable to Saba than having no park. This was true for all scenarios. Compared to a “no park” alternative, the mix of objectives indicated by the people of Saba as most important can be better achieved by the current management regime. Further, the objectives expressed by the community are better served with a marine park that includes a "No fishing" zone. The degree of concurrence in these results was surprising given the differences in importance attributed to the four main objectives by the different stakeholders.

The desired objectives of the Saban community can be achieved even better, however, by a marine park that has greater communication and education components, and a more rigorous strategy of compliance to the Saba Marine Park Ordinance and recognition of use limits. Both these management alternatives were assessed to be valuable additions to the marine park.

The analysis generated almost the same preferences for future management alternatives for Saba Marine Park under all scenarios. In the oil-spill scenario, however, a Marine Park with more authority (e.g., to demand assistance and compensation from the guilty agent) would be most desirable. The main effect of conducting the analysis under different future scenarios was on the level of achievement of objectives rather than on which management alternative was best (Appendix I). Results suggest that **under scenarios of large increases in tourism growth and major coastal construction, the Saba Marine Park might not be able to achieve the community defined objectives as well as under a status quo scenario**.

In sum, based on the stated preferences of the Saban community, the relative value of Saba Marine Park management options are (in descending order):
(1) a marine park with greater communication and education components;
(2) a marine park that enforces regulations and prevents over-use;
(3) the marine park as it currently is;
(4) the marine park without the "No fishing" zone and
(5) no marine park at all.

The optimal future management direction adopted by Saba Marine Park could be a combination of those presented here. Experienced judgment or optimization programming may indicate what combination of management options would be most successful in achieving the community identified objectives of Saba Marine Park.

RECOMMENDATIONS

These recommendations were mainly generated from concerns and suggestions expressed by people within the Saban community. Some of the recommendations could contribute to achieving multiple objectives.

1. The existing "No fishing" zone in the Saba Marine Park should remain.

2. Increase the education of Saban school children with regard to Saba's marine environment, in general, and Saba Marine Park, specifically. For example, SMP could:
   - 2.1. communicate with educators as to how more marine education can be included in the curriculum;
   - 2.2. support school "field trips" to SMP;
   - 2.3. initiate swimming/snorkeling lessons;
   - 2.4. initiate/facilitate SCUBA diving as part of school sports or as extra-curricular activity;
   - 2.5. facilitate informing educators and children of the types of jobs available in the marine environment (specifically Saba's marine environment) and education/training required for these;
   - 2.6. require researchers with the SMP to make themselves available to the schools to teach a lesson/give a talk;
   - 2.7. instigate a volunteer program for high school students over the summer.

3. Increase the amount of interaction of SMP with community. For example, SMP could:
   - 3.1. make more use of various media to communicate to the public;
   - 3.2. sponsor events to heighten awareness of marine environment and SMP.;
   - 3.3. require researchers with SMP to write and send out press releases on their work;
   - 3.4. sponsor activities with children that require parents' attendance/involvement;
   - 3.5. co-ordinate with fishers on putting in moorings for fishing in "All purpose" or "Multiple use" zones;
   - 3.6. share information which could be of use to local businesses;
   - 3.7. explicitly invite Sabans to attend the Tuesday night slide show at Juliana's;
   - 3.8. let dive shops know that SMP is aware of and appreciates their assistance.

4. Increase the amount of awareness and understanding regarding SMP with government decision makers. For example, SMP could:
   - 4.1. ensure positive as well as negative information on SMP reaches government;
   - 4.2. continue to advise government on environmental impacts of development proposals;
   - 4.3. communicate with government on carrying capacity for SMP with regard to informing government planning decisions;
   - 4.4. discuss the concept and implications for SMP (and Saba) of integrated long-term development planning.

5. Saba Marine Park should make greater effort to enforce compliance with the Marine Environment Ordinance. For example, SMP could:
   - 5.1. patrol more often and/or more irregularly;
   - 5.2. be less lenient in enforcing the rules;

5.3. re-emphasis and/or check whether SMP rules are being conveyed to divers.

6. Saba Marine Park should introduce rules protecting the marine environment from downstream effects and overuse. This includes effects originating both within and outside Saba. For example, SMP should:

6.1. introduce rules or legislation regarding cleaning of boats in SMP;
6.2. introduce rules or legislation preventing human induced silt/sediment flow into SMP;
6.3. gain special law enforcement authority for SMP staff;
6.4. introduce financial incentives to deter catastrophes and unexpected environmental damage.

7. Saba Marine Park should instigate research into a biological carrying capacity or limits of acceptable biological change for the marine park of Saba.

8. A rigorous system of Environmental Impact Assessments for any (terrestrial or marine) projects potentially impacting Saba's marine environment should be implemented through legislation wherein the SMP is the responsible authority and the developer is the financier.

ACKNOWLEDGMENTS

Without the foresight and enthusiasm of the Executive Council, past and present managers of SMP and, especially, the chair of the Saba Conservation Foundation this work would never have been instigated.
It is the people of Saba, however, to whom the biggest thanks is owed for their discussions with me, their responses to my questions (verbal or written) and attendance of the meetings. It is my hope that they consider their concerns to be adequately represented in this work and that their reward is that their wishes be heard and attended to by the decision makers of Saba.
I thank the dive shops, most especially Sea Saba, for giving me access to their divers (early on) and access to the SMP for purposes of both data collection and inspiration. I thank Percy Ten Holt, Joycelyn Simmons and the Johnsons at Juliana's for their assistance at different times.
I also thank John Dixon, Sharyn Fernandes, Erik Meesters, Mark Ridgely and Kirk Smith for their input.
This work was funded by The Center for Cultural and Technical Interchange between East and West (The East West Center) in the U.S.A. and the World Wildlife Fund - The Netherlands.

INTRODUCTION

Background

Saba is in the process of developing very rapidly: in the last 25 to 30 years the island has seen the introduction of roads, an airport, permanent access to electricity and a port and, consequently, tourism has increased from about 1300 (in 1962) to about 23000 per annum (Mol 1989, Saba Tourist Bureau unpublished data). Many tourists are visiting Saba to SCUBA dive. In 1987, the government of Saba had the foresight to implement the Marine Environment Ordinance which established Saba's Marine Park. This park was installed before the marine environment had suffered much damage at the hands of divers, boat anchors or from overfishing.

After installing the marine park, the government encouraged dive operators and divers to come to the island in an effort to increase the private sector of the economy. That effort has been successful in that the number of divers coming to stay on Saba has more than doubled since that time and they now spend over one million dollars per year whilst visiting (Framheim in prep). This has led to an increase in employment in the tourism industry and to a positive impact on the incomes of roughly 18% of Saba's working population (Joint Commission on the Integral Development of Saba and St. Eustatius, 1994).

The pressure on Saba to develop further is increasing both from local constituents but also outside investors (Saba Government Planning Office, unpublished data). These pressures could lead to negative repercussions for Saba in general and for the marine resources of Saba in particular.

In the context of this concern about possible future impacts on the marine environment, this research provides an integrated evaluation of future management alternatives for the Saba Marine Park (SMP). This work was initiated in a pro-active move by the Saba Conservation Foundation[1] and SMP with the support of the Executive Council.

Research approach

The Saba Marine Park (SMP) is managing Saba's marine resources for the people of Saba. Being such, an evaluation of SMP should reflect the degree to which it has achieved the objectives that the people consider appropriate for their marine park. These objectives have never been made explicit thus the first stage of the research was to determine what the Saban people want from SMP. Certainly economic benefits of management were desirable and these are being explored in detail in a concurrent study (Framheim in prep). This study, however, incorporated all the benefits Sabans wanted from SMP: economic, environmental, social etc. These benefits were translated into multidimensional objectives. The achievement and relative desirability of the objectives were then evaluated using techniques from the field of multiple criteria analysis rather than economics.

Multiple Criteria Analysis

[1] Saba Conservation Foundation consists of seven members including one non-Saban.

Multiple criteria analysis (MCA) is a body of principles and techniques developed, in part, in response to the perceived limitations of economic approaches to evaluation of alternative projects or decision choices (Goicoechea et al. 1982, Zeleny 1982). Evaluation techniques within MCA can integrate the multiple dimensions of decision making as well as allow for trade-offs between them unlike most economic analyses. Thus, social and ecological benefits of a project can be considered, as well as economic benefits, within one evaluation framework. Value, in these evaluations, is attributed to the degree to which the most important objectives can be achieved. The various types of benefits (and costs) are often normalized in some way to permit comparison and tradeoffs between them. An advantage of MCA techniques is that they do not necessarily assume rational choice behaviour, perfect markets or equity in the monetary unit of measure. Qualitative as well as quantitative data can be used in these types of analyses (e.g. Zeleny 1982, Ridgley and Chai 1990). The analytical approach can be top down, with most of the input coming from the decision makers and the analyst or bottom up. A bottom up approach focuses on analyzing information gathered from all those people with some interest or stake in the decision at hand. This analysis took a bottom up approach.

Overall research aim

The aim of this work was to assess the multi-faceted value of Saba Marine Park to the Saban community. This evaluation provides a more comprehensive base of information upon which to make decisions which may impact the future functioning of the park. Within the framework of the overall study, specific research aims were to:

1. determine what objectives the Saban community wishes the Saba Marine Park staff to work towards;
2. define feasible alternatives for the management of Saba's marine resources based on input from the community;
3. describe possible future conditions under which the defined management alternatives might have to function and
4. assess the relative value of the alternative management directions.

METHODS

Multiple criteria analytic techniques are used in this study. These techniques are many and varied, however, the procedure for addressing any problem situation is fairly standardized and can be summarized in nine steps (Appendix A).

The manner in which each step of the procedure was executed for this evaluation of Saba Marine Park (SMP) is outlined here. The first component of the evaluation required identification, organization and prioritization of community defined objectives. Degree of achievement of these objectives then becomes the basis of assessment of alternative SMP management directions, including SMP as it presently exists.

Step 1. Define the problem.

The Saba Conservation Foundation (SCF) initiated interest in this research. Thus, their chairperson was interviewed to determine the specific reasons for having this work conducted and what the work was to achieve.

Step 2. Identify the stakeholders.

Groups of people with an interest or stake in the SMP were identified in early discussions with Sabans and long term residents of the island who had some familiarity with SMP. Visiting SCUBA divers were considered a separate stakeholder group. Although they do enjoy Saba's protected marine environment and contribute to the economic benefit of the local community, they are not part of Saba as are Saban residents.

Step 3. Identify the objectives.

Personal semi-structured interviews were conducted with approximately 50 residents of Saba including individuals from all the identified stakeholder groups (Appendix B). The aim was to solicit opinions from a variety of Saban residents, rather than to sample the population in a statistically representative manner. From these interviews, community opinions as to the desired objectives of SMP were extracted. The identified objectives were reviewed, as to their validity, at a public meeting and at two small group meetings. A representative from each of the stakeholder groups was invited to the small group meetings although not all were able to attend. A one page newsletter was distributed requesting further input and criticism on identified objectives. The opinions of visiting divers were collected using semi-structured mailed surveys sent to divers through the SCF Newsletter. The questions used are provided in Appendix B.

Step 4. Structure the objectives.

The objectives identified in step three were summarized and structured into a hierarchy (or value tree) with several branches and multiple objectives within each branch. Each group of lower level objectives contributes to the objective above it. Ultimately, all lower level objectives contribute to one overall goal. The resulting objectives hierarchy was reviewed by the decision makers involved and at two small group meetings with stakeholder representatives.

Step 5. Establish attributes.

These attributes are yardsticks by which to measure achievement of objectives. Attributes may be quantitative or qualitative and provide a base upon which objectives can be normalized and compared to each other. Attributes were chosen in consultation with the SMP manager and chair of the SCF.

Step 6. Derive priorities for the identified objectives.

Comparing preferences: The importance of objectives was determined in relation to how much they are considered to contribute to the next highest objective within the hierarchy. For example, within any specified overall goal one might assess the relative importance of economic, social and ecological objectives to achieving the overall goal. The relative importance of objectives was compared in a pairwise manner (between two objectives at a time) on a nine point scale ranging from "Equal importance" to "Extremely more important". The pairwise comparison and nine point scale provides a most workable representation of the way people think and compare similar elements. This technique also derives ratio scale priorities of objectives (Saaty 1977).

Multiple stakeholder input: Relative importance of objectives at all levels of the hierarchy were determined by the SMP manager and chairperson of the SCF. The Executive Council and a representative from each stakeholder group prioritized the top level objectives only. In this way, the relative value of sub-objectives (e.g. fish abundance or water quality) WITHIN the objective of ecological sustainability remained the same. What changed was the weight of the highest level objectives (e.g. ecological and economic objectives) relative to each other depending upon the preferences of the stakeholders. These stakeholders considered that their views on the relative importance of lower level objectives would be well represented by the manager of SMP and chair of SCF.

Implementation of the following steps lead to definition and evaluation of the various SMP management alternatives. Evaluation is based on how well the alternatives fulfill the objectives the community desired for the future management of their marine resources under particular future scenarios.

Step 7. Define management alternatives.

Suggestions for management of SMP were extracted from the interviews conducted in the Saban community. These, together with input from the SMP manager, SCF chairperson and the author, were complied into 5 major management alternatives for evaluation. These alternative future management directives were reviewed and approved by the Executive Council.

Step 8. Construct possible scenarios.

Under different sets of development or disaster conditions (scenarios) various management alternatives might work more or less successfully. That is, the degree to which management alternatives are desirable in terms of achieving objectives might vary under different scenarios. The basic scenario is a status quo situation. The sensitivity of resulting preferences for management alternatives to different scenarios can be tested by reconstructing the evaluation under different (non status quo) sets of future conditions. Future possible conditions under which the SMP might have to operate were generated based on input from the community, SMP manager and SCF chairperson.

Step 9. Evaluating management alternatives.

Multiple Criteria Evaluation tool: The particular multiple criteria analytic technique chosen for the evaluation depends largely on the characteristics of the situation being

analyzed. Matching of the characteristics on Saba with the characteristics of the techniques available was conducted using the selection methods described in Hwang and Yoon (1981), Janssen et al (1984), Janssen (1990) and Edwards and Newman (1982)(for more details contact the author). The technique chosen was the Analytic Hierarchy Process (Saaty 1982). This technique provides decision support by combining judgment and personal values in a logical way. The process requires organization of objectives within a hierarchy (Step 4) and pairwise comparison of objectives on a nine point scale (Step 6).

Time frame: The actions, regulations and results of any chosen management regime would take time to implement and bear fruit. For this reason, the evaluation of cases was conducted based on a 5 year lapse.

How management alternatives were evaluated: Evaluations were conducted by combining prioritized objectives and management alternatives with prescribed sets of future conditions (scenarios). Evaluation produces the relative value of each of the management alternatives in terms of achievement of each (stakeholder prioritized) set of objectives. Achievement of each lowest level objective may be measured quantitatively or assessed subjectively by stakeholders or decision makers based on quantitative or qualitative information. These assessments are made with reference to attributes which are the chosen yardsticks by which to measure achievement of objectives. By assessing how well each management alternative achieves the lowest level objectives it is possible to calculate the degree of achievement of the next highest objective and, ultimately, the overall goal.

Base model for evaluation: In this analysis, achievement of objectives was assessed qualitatively by the manager of SMP and chair of SCF. Again, stakeholders agreed than the opinions of the manager of SMP and the chair of the Saba Conservation Foundation (SCF) would adequately reflect their views on this under status quo conditions. The results are the relative value of different management alternatives to these decision makers under status quo conditions. Their hierarchies provided the base models for analysis. Preferences for particular management alternatives are thus based on the importance stakeholders place upon particular objectives and which management alternative can best achieve those objectives.

Evaluation under non-status quo conditions: Deviations in preferences for management alternatives under non status quo conditions were estimated from base models by the author as requested by the decision makers. Different management alternatives may be better able to achieve certain objectives under different (non status quo) scenarios.

In all, the five management alternatives were evaluated under 4 different scenarios for 15 different stakeholders within two differently prioritized (base model) hierarchies.

RESULTS

Step 1. Defining the problem.
The Saba Conservation Foundation (SCF) expressed a concern that, in the future and with a lack of appropriate information, decision makers will be unable to adequately assess some choices concerning Saba Marine Park (SMP). This was considered particularly pertinent given the increasing domestic and foreign development pressures which could lead to trade-offs between, for example, economic, social and environmental objectives of SMP. SCF and the SMP also wanted to explore the desirability of the present and alternative management directions based on the opinions of the Saban community. No methodical assessment of the value of the park to Saba and Sabans had been conducted upon which to base decisions. The aim of this work, therefore, was to redress these omissions.

Step 2. Identify the stakeholders.
Stakeholders included the decision makers which were identified as the Executive Council (a three person government authority), SCF chairperson and SMP manager. Other stakeholders have been, relatively arbitrarily, grouped into people owning or working in art galleries, dive shops, gift and souvenir shops, grocery stores, hotels, restaurants, taxis, the tourist office as well as developers, builders, educators, politicians, recreational fishers and schoolchildren. Visiting divers were identified as important, non resident, stakeholders.

Step 3 and 4. Identify and structure the objectives.
The objectives were derived from 33 written responses from school students, 48 interviews and a public meeting attended by about 50 people. Excluding the public meeting, my sample included 6.6% of the total population of Saba. A comparison of the sex and age structure of the Saban population with my sample is provided for reference (Figure 1A and 1B).

Figure 1A. Sample versus population age distribution of Saban females

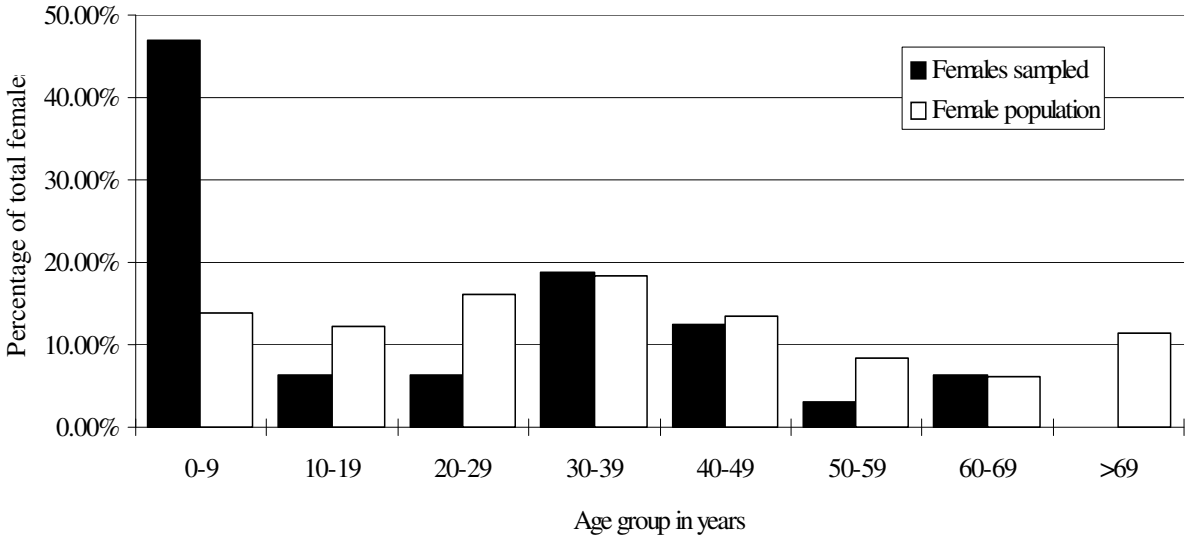
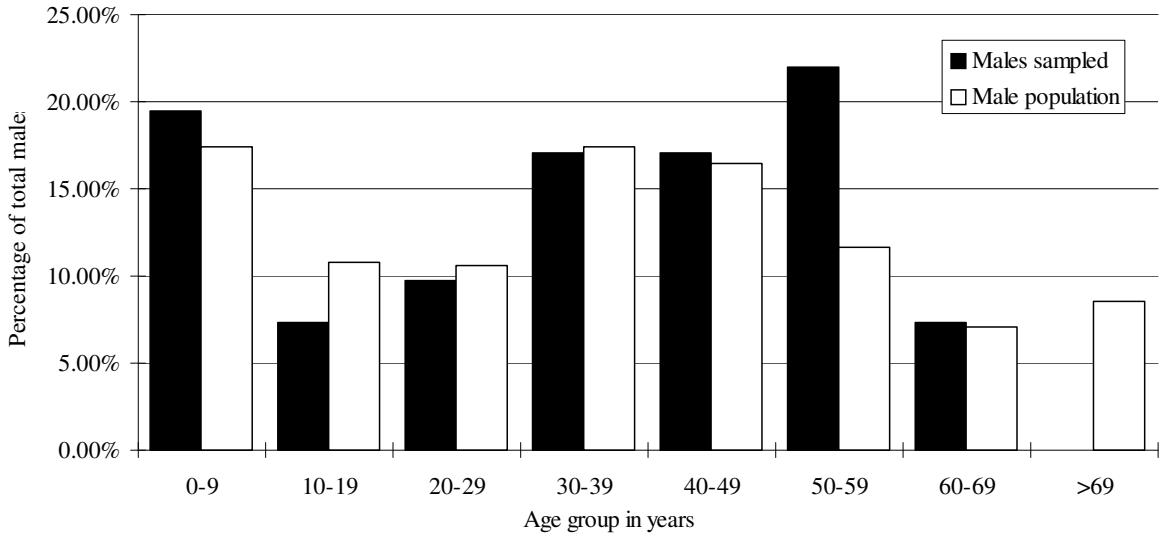


Figure 1B. Sample versus population age distribution of Saban males



Of the interviewees 35.4% were black people, the remainder being caucasians. In the absence of demographic information on racial origin, it is difficult to assess whether this sample is biased in terms of the racial distribution of respondents.

The questions used to guide the written and verbal responses are given in Appendix B. A summary of the resulting collection of objectives, opinions and concerns together with the frequency that they were stated is given in Table 1 (the complete collection of these is given in Appendix C).
In addition, ninety five divers responded to mailed questionnaires (in Appendix B). Their responses are explored separately in the results after step nine.

Table 1. Summary of the main desired and perceived Saba Marine Park management objectives, management suggestions and concerns expressed by the people of Saba. "Students" refers to school students. The issues in bold were mentioned at least once at the public meeting also (see Appendix C).

Summary of responses	Frequency mentioned:	
ENVIRONMENTAL ISSUES	Public	Students
Maintenance of ecosystem (e.g. protecting the fish and/or coral, **maintaining water quality**)	43	28
Require a carrying capacity	20	4
Decreased anchor damage associated with mooring system	15	10
Patrolling and enforcement is important and should increase	13	
Impact per diver decreased by education	11	
Monitoring is important	10	

Table 1. cont.

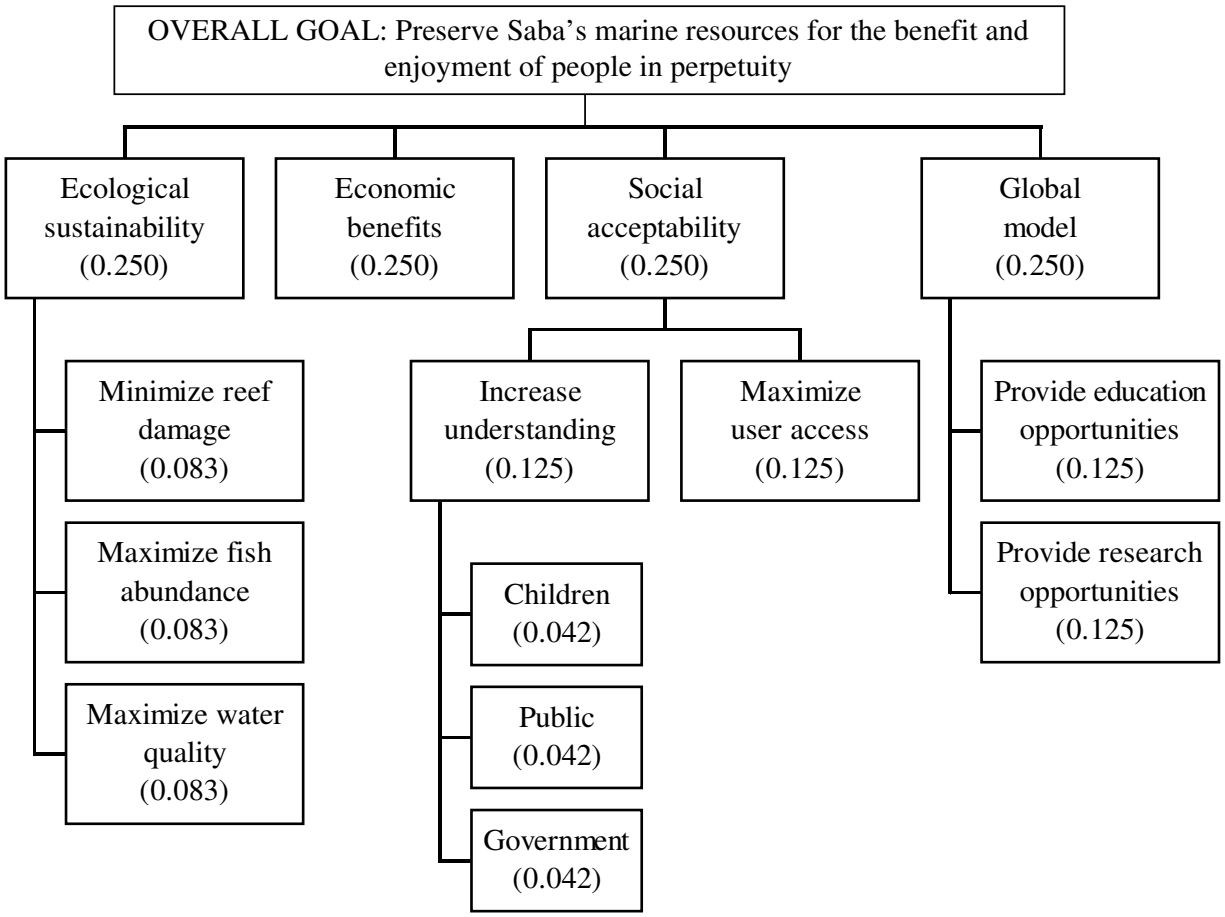
Fishers are being excluded and people fish less now	8	
Oil spill from St. Eustatius is of concern	8	
Expand the size or authority of SMP with regard to protection against future development	7	
Fish abundance is and should be increasing	5	10
SOCIAL ISSUES	Public	Students
Education of local children	24	14
More communication/interactions with community	27	10
SMP attracts a desirable type of visitor	21	
Minor conflicts between SMP and SMP users	16	13
More support for SMP now, especially from fishers, as the economic benefits become apparent	16	
There is more appreciation and understanding of marine environment now	14	5
There's no conflict between fishers and SMP now	13	
No social impact of SMP	12	

Minor conflict exists between different SMP users	10	
Local access to resources is important	9	
Sabans not interested and don't know about SMP	9	
Dive operators co-operate with SMP*	6	3
ECONOMIC ISSUES	Public	Students
Increased development on Saba is associated with SMP via divers and yachts	37	11
SMP is financially independent of Saba	11	
People engaged in better paying jobs partially because of SMP	9	
POLITICAL ISSUES	Public	Students
Want SMP to continue advising government regarding developments which could impact the marine environment	14	

*The SMP and dive operators are also often thought to be the same group of people.

The objectives hierarchy generated based on these data (Table 1 and Appendix C) is illustrated in Figure 2. The overall goal was identified as "Preserving the marine resources of Saba for the benefit and enjoyment of the people in perpetuity". "The people" refers primarily to the residents of Saba but also to visitors and outsiders. Main objectives are to attain ecological sustainability, economic benefits, social acceptability of management and offer the SMP as a model from which others can learn. The latter was considered important by two decision makers on Saba and agreed upon in discussions at two small group meetings where representatives from all the stakeholder groups were invited. It was also considered that other stakeholders can choose to give this objective an extremely low weighting if they consider it unimportant. All these objectives and their sub-objectives are defined in more detail in the legend of Figure 2 on the next page.

Figure 2. Community derived objectives for Saba Marine Park, structured into an objectives hierarchy. Numbers in parentheses are the default weightings given to each objectives presuming all objectives are equally important to achieving the overall goal. The legend is on the next page.


OVERALL GOAL: Preserve Saba's marine resources for the benefit and enjoyment of people in perpetuity
Ecological sustainability (0.250)
Economic benefits (0.250)
Social acceptability (0.250)
Global model (0.250)
Minimize reef damage (0.083)
Maximize fish abundance (0.083)
Maximize water quality (0.083)
Increase understanding (0.125)
Maximize user access (0.125)
Children (0.042)
Public (0.042)
Government (0.042)
Provide education opportunities (0.125)
Provide research opportunities (0.125)

Legend to Figure 2.

Abbreviated name of objective used: explanation of objective.

Ecological sustainability: maintaining ecological sustainability and maximizing environmental quality of the marine environment.

- **Minimize reef damage**: minimize physical and disease damage to benthic organisms.
- **Maximize fish abundance**: maximize the number and size of the greatest diversity of fish species possible.
- **Maximize water quality**: prevent or minimize all organic or inorganic anthropogenic pollution.

Economic benefits: ensure that the Saba Marine Park (SMP) has a positive economic effect on the community of Saba.

Social acceptability: maximize the social acceptability of SMP and its management actions.

- **Increase understanding**: increase awareness and understanding within Saba for the value and functioning of the marine environment, marine resource management practices in general and SMP in particular.
  - **Children**: increasing children's understanding of the marine environment, marine resource management and SMP.
  - **Public**: increasing the awareness of the community as to the value and functioning of their marine environment and marine park.
  - **Government**: increasing the awareness of government decision makers as to the value and functioning of Saba's marine environment and SMP particularly as it pertains to government decisions which may impact the park.
- **Maximize user access**: allow for maximum multiple use of SMP whilst minimizing conflicts between different users.

Global model: SMP provides a global example of a self-financing, well functioning marine park from which people can learn.

- **Provide education opportunities**: the global community can learn from SMP through education both directly (hands-on) and indirectly (via texts and publications).
- **Provide research opportunities**: both the relatively pristine environment and the marine park itself can be the focus for, respectively, biological and management oriented research world wide.

Step 5. Establish attributes.
The attributes chosen by which to measure the degree of achievement of objectives are briefly outlined in Table 2. These were the measures by which success of various management alternatives was considered by the decision makers (manager of SMP and chair of SCF)(step 9). It is also the measure by which the success of any chosen management alternative can be considered over time (Appendix J). If a management alternative was considered to lead to improvements in these "yardsticks" then it was preferable to a management alternative which did not. The attributes include quantitative and qualitative measures. As more reliable information becomes available the attributes can be updated or improved. Details of the attributes are supplied in Appendix D.

Table 2. Attributes chosen to measure degree of achievement of each of the lowest level objectives of the Saba Marine Park (SMP) objectives hierarchy (in Figure 2).

Objective[1]	Abbreviation[2]	Attribute
Minimize reef damage	Minimize reef damage	Physical damage to coral colonies
Maximize fish stocks	Maximize fish abundance	Changes in biomass of fish families
Maximize water quality	Maximize water quality	Qualitative estimate of pollution from oil, nutrients, sediment and garbage
Contribute positively to the income of the Saban community	Economic benefits	Amount of annual spending by divers
Increase children's understanding of marine environment and SMP	Children	Number of lessons per year including the marine environment or SMP
Increase public awareness of marine environment and SMP	Public	Number of media exposures per year
Increase government awareness of marine env. impacts and SMP	Government	Degree of satisfaction in SMP: government interactions as per SMP and SCF.
Minimizing conflicts of access and interest between users	Maximize user access	Qualitative assessment of degree of conflict by SMP based on number of warnings, complaints
Global education about marine biology and management using SMP as a model	Provide education opportunities	Satisfaction felt by SMP and SCF in degree of hands on educat'n and textual exposure
Scientific research into marine biology and management using the SMP as a model	Provide research opportunities	Satisfaction felt by SMP and SCF in amount and type of research conducted

[1] Objectives defined in more detail in the Legend to Figure 2.
[2] Abbreviations as used in the objectives hierarchies (Figures 2,5,6 and 7).

Step 6. Establish priorities for the identified objectives.
The complete priorities of the manager of the SMP and the chair of the SCF with regard to the identified objectives of the marine park are presented in Appendix E. The priorities of all the stakeholders with regard to the relative importance of the top level objectives are given in Table 3.

Table 3. Relative importance (priorities) of top level Saba Marine Park (SMP) objectives in contributing to the overall goal of "Preserving the marine resources of Saba for the benefit and enjoyment of the people in perpetuity". The priorities given are as judged by one individual from each stakeholder group.

	Objective*			
Stakeholder groups	Ecology	Economic	Social	Global
Executive Council 1	.323	.221	.285	.171
Executive Council 2	.309	.388	.249	.054
Executive Council 3	.290	.470	.200	.040
Saba Conservation Found'n	.476	.093	.360	.071
SMP	.676	.114	.105	.105
Recreational fishers	.525	.168	.177	.129
Gift/souvenir shops	.401	.126	.277	.197
Hotel/restaurants	.293	.285	.260	.163
Grocery stores	.344	.094	.143	.419
Dive shops	.683	.111	.150	.056
Tourist bureau	.225	.349	.315	.111
Educators	.600	.230	.057	.114
Politician	.181	.151	.605	.064
Art galleries	.404	.131	.207	.259
Developer	.283	.529	.095	.093
Default value (for comparison)	.250	.250	.250	.250
Maximum value	.683	.529	.605	.419
Median value	.344	.168	.207	.111
Minimum value	.181	.093	.057	.040

* The definition of these objectives is provided in the legend of Figure 2.

With changes in the relative weighting given to top level objectives, the absolute value of the lower level objectives changes. The changes throughout the hierarchy are proportional to the new priorities generated at the top level by the different stakeholders. Individuals in some stakeholder groups were unwilling or unable to present their views. The extreme values for each objective were identified.

On the whole, there was a tendency to give higher priority to maintaining the ecological balance of the marine environment of Saba. Nine of the individuals from the fifteen different stakeholder groups considered that ecological sustainability was of greatest importance in achieving the overall SMP goal. Beyond that priority was given to economic and social objectives rather than to providing a global opportunity for learning.

These results were quite interesting. Predictably, the individual from the political stakeholder group, for example, expressed most concern over the social acceptability of SMP and the developer considered that economic benefits were of paramount importance. Two of the three executive council members shared this view with the developer. All viewed ecological sustainability as contingent upon these other objectives being achieved. Interestingly, the representative from the dive shops placed greatest importance on maintenance of the marine ecosystem and, after the politician, the chair of the SCF gave most weight to the social objectives of SMP. Curiously, the educator interviewed considered that the social objectives of SMP, including education, were of least importance to successful management. The recreational fisher indicated that a sustainable environment was of primary importance but that further communication and interaction with the Saban community was also important. The grocery store owner expressed the opinion that, given the current state of functioning of SMP, most future emphasis should be placed on providing a global opportunity for education and research using the SMP as a management model. He was also of the opinion that the economic benefits of SMP should be de-emphasized in the future.

The next component of the research is the evaluation of the Saba Marine Park (SMP). Value is attributed to the present or alternative management directions dependent upon the degree of achievement of the objectives set by the Saban community. The value of any SMP management alternative is considered in relation to other management strategies and in context of different possible future scenarios. Thus, the evaluation combines the community identified SMP objectives, stakeholder priorities for those objectives, management alternatives and scenarios.

Step 7. Define future management alternatives for SMP.

In any project evaluation, there is always a comparison to the status quo situation and the no project situation. These norms were applied here and thus "SMP as it currently is" and "No SMP" comprise two of the five management alternatives defined. The other management alternatives were a compilation of suggestions mainly from the Saban community but also from the SMP manager, SCF chairperson and the author.

The third management alternative investigated was Saba Marine Park as it currently is WITHOUT the present "No fishing" zone. In this alternative, all the other rules and regulations would remain, however, locals would be allowed to line fish from stationary boats within the area currently designated as "No fishing". Currently, the only fishing allowed within this area is line fishing from shore and trolling.

The fourth management alternative considered was SMP as it currently is but with a larger education, communication and public interactions component.

The final alternative considered was a SMP as it currently is however including a greater degree of enforcement and authority. For example, more patrols, institution of a diver carrying capacity and on the spot fines for second time violators.
More detail about what these alternative management directions might entail is given is Appendix F.

Step 8. Construct possible scenarios.
Scenarios are different sets of future conditions under which the SMP may have to operate. These provide an opportunity to explore the sensitivity of the evaluation to differences in future conditions. The scenarios constructed include the status quo which includes approximately 10% increase in tourists per annum, a major oil spill from St. Eustatius, a major increase in the number of tourists (say 20% per year) and a major coastal construction e.g. at Giles Quarter. In all scenarios, all conditions not specifically described are assumed to remain at status quo.

Step 9. Evaluation of cases.
The relative value of the five different management alternatives was based upon the degree of achievement of the community defined and prioritized objectives of Saba Marine Park. The results were generated by application of the Analytic Hierarchy Process. The evaluations were underpinned by the two base models defined by the decision makers of the Saba Conservation Foundation and Saba Marine Park. For this reason, the detailed results of the analyses of these models are given in Figure 3A-D. This figure shows these stakeholders' preferences for different management strategies when attempting to maximize achievement of each objective in turn, rather than simultaneously.

For the complete evaluation, preference for the alternative management directions varied depending on the particular stakeholder preference for certain objectives and the scenario under which the evaluation was conducted. The five management alternatives (step 7) were evaluated under the 4 different scenarios (described in step 8), for 15 different stakeholders (Table 3) within the two differently prioritized (base model) hierarchies (Appendix E and Figure 3). After each evaluation of the status quo scenario the results were displayed to the stakeholder being interviewed. Resulting values of alternative management strategies were discussed with regard to how well they represented the stakeholders concerns and opinions. In all cases, there was agreement that results were a true reflection of their opinions. What follows are the results of this step.

Results of evaluation of Saba Marine Park (SMP) management alternatives

In all cases evaluated, a Saba Marine Park as it currently exists was far more valuable than no marine park or a marine park which allows line fishing everywhere despite the variety of values held by different stakeholders (Figures 4.A-D; Appendix G and H). Line fishing would be allowed everywhere in the park if the decision makers chose the SMP management alternative of eliminating the "No fishing" zone. Under all scenarios, the present SMP is more able to achieve economic, social, environmental and global learning objectives than less rigorous management regimes (Appendix H). If the marine park ceases to function it was estimated that, given the time span considered, the amount of diver spending would begin to decrease, there would be less understanding and awareness within the children and community as to marine ecology or management and there would be increasing conflicts between increasing numbers of unregulated users.

Figure 3A. Relative preference for alternative management strategies when MAXIMIZING ENVIRONMENTAL QUALITY AND ECOLOGICAL SUSTAINABILITY. Priorities are those for the decisionmakers of SMP and SCF. Results include analysis of all scenarios (Appx. H).

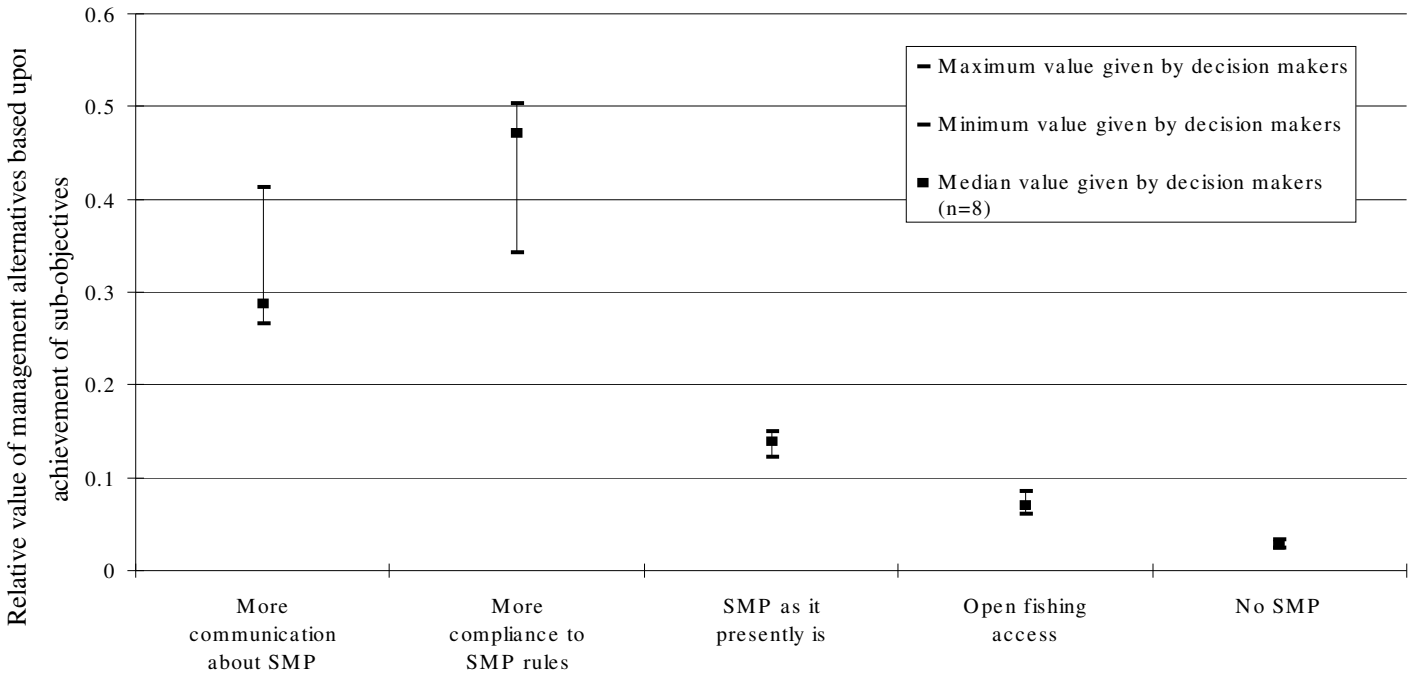


Figure 3B. Relative preference for alternative management strategies when MAXIMIZING THE ECONOMIC BENEFITS OF SMP TO THE COMMUNITY. Priorities are those for the decisionmakers of SMP and SCF . Results include analysis of all scenarios (Appx. H).

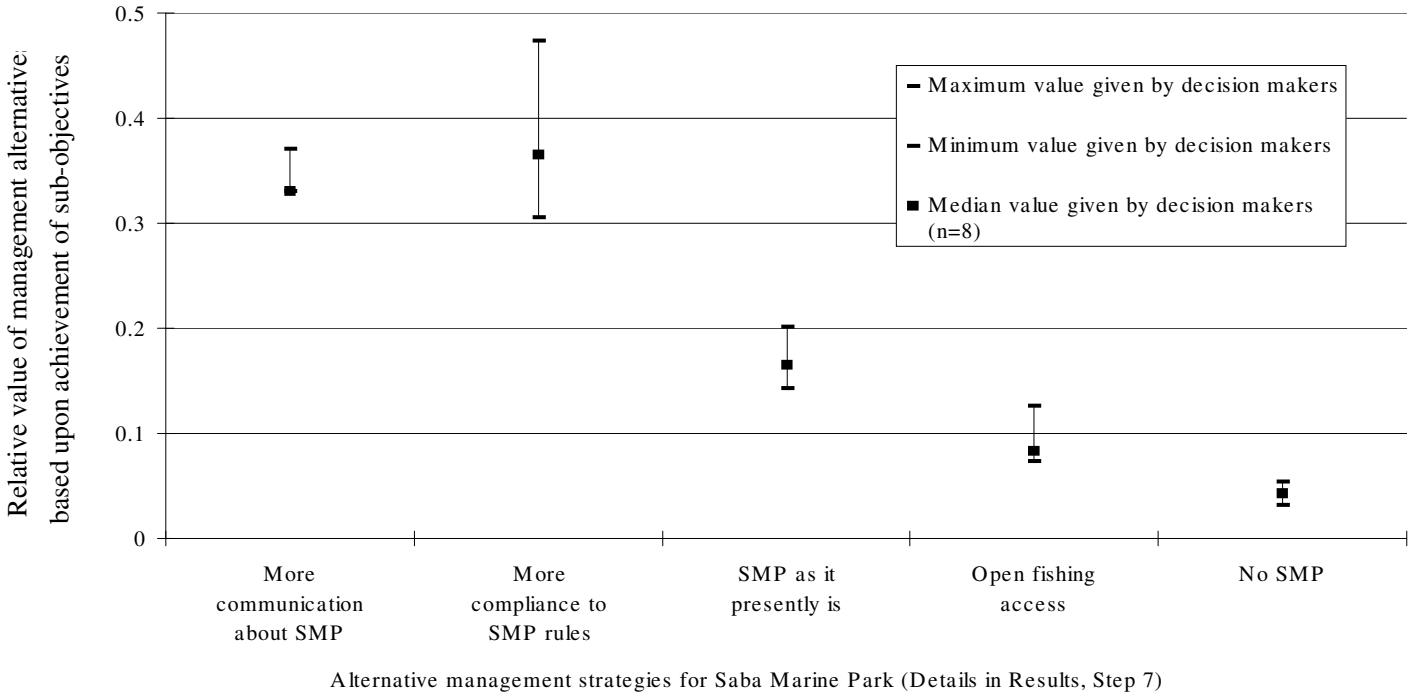


Figure 3C. Relative preference for alternative management strategies when MAXIMIZING SOCIAL ACCEPTABILITY AND UNDERSTANDING OF SMP MANAGEMENT. Priorities are those for the decisionmakers of SMP and SCF. Results include analysis of all scenarios.

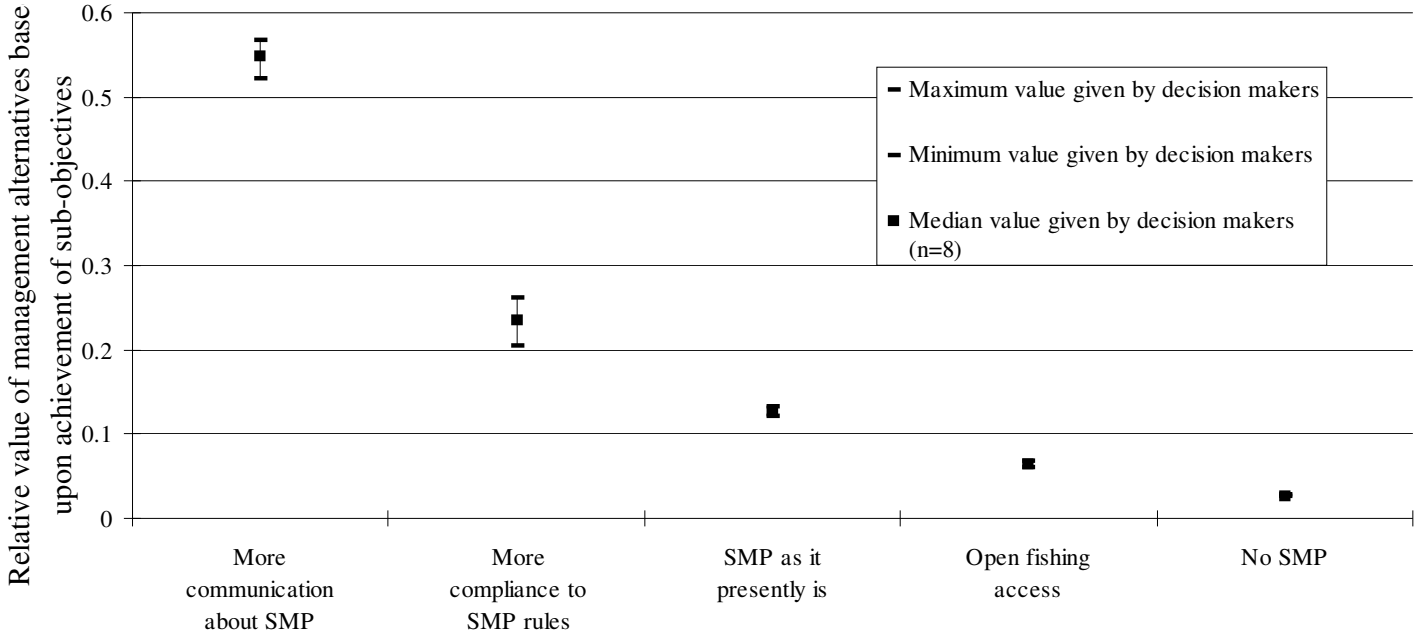
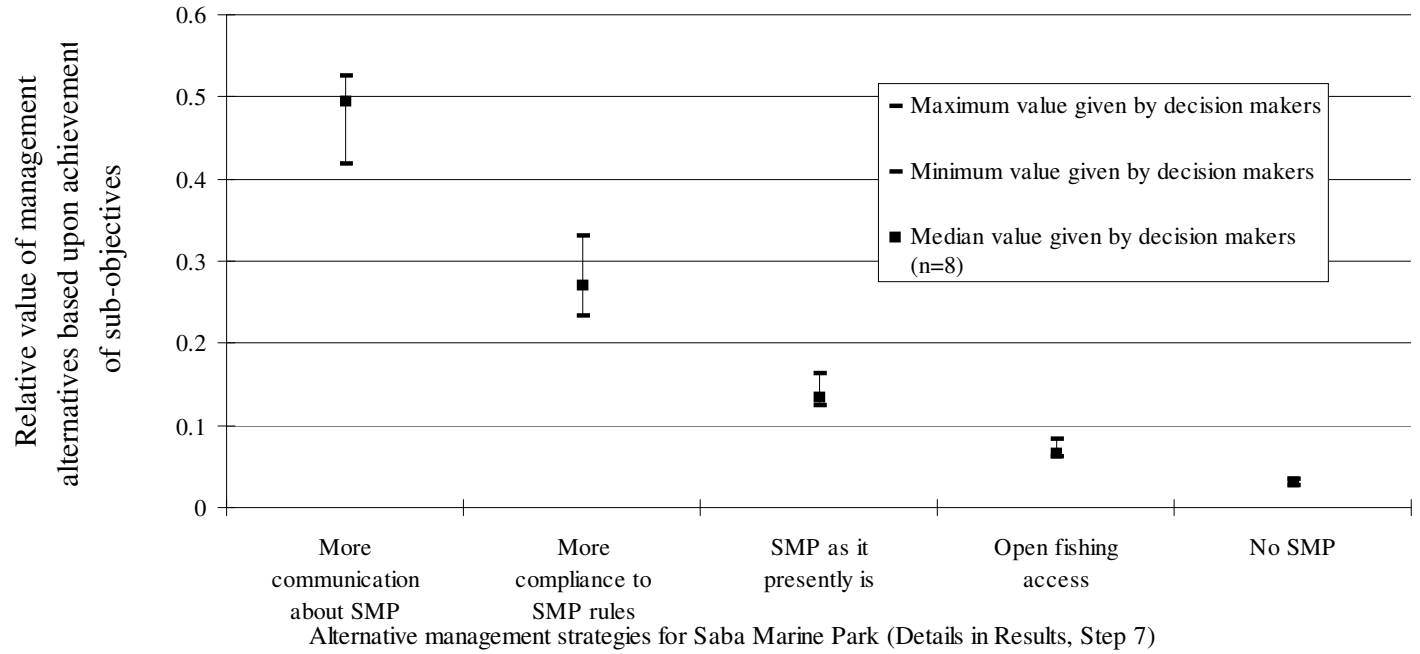


Figure 3D. Relative preference for alternative management strategies when MAXIMIZING THE GLOBAL OPPORTUNITY TO LEARN USING SMP AS A MODEL. Priorities are those for the decisionmakers of SMP and SCF. Results include analyses of all scenarios (Appx.H)



The evaluation also indicated that there is room for improving the management of SMP (Figure 4, Appendix G). In all cases, a marine park with a greater education and communication component is more valuable in terms of achieving the desired objectives than the SMP as it presently is. More involvement in education means, for example, that the children of Saba will not only understand and appreciate their marine resources more but they can learn how to educate themselves for jobs working in the marine environment. More communication with the public would mean that a greater community understanding can be built as to what is acceptable within the marine park and why some activities are limited in some areas. More community involvement also means that the SMP can respond better to the needs and desires of the Saban people.

Similarly all stakeholders' objectives could be better met by encouraging greater compliance to rules and stricter regulation of damaging activities (Figure 4 , Appendix G). For example, the threat of on the spot fines for polluting yachts would discourage effluent discharge into the SMP waters. Stricter control over outside vessels bringing divers to Saba would have economic as well as environmental benefits for the island. Working to establishing limits to diver numbers would mean that the economic, social and ecological objectives of the SMP and the Saban people have a better chance of being achieved "in perpetuity" rather than only for the next few years.

Achievement of differently prioritized stakeholder objectives varied between a SMP with more communication and education activities and a SMP which enforces more public compliance to rules (Figure 4, Appendix G). It depended, in part, on the scenario under which the analysis was conducted. Under a status quo scenario, in 89% of the evaluations more communication and interaction between the Saban people and SMP was preferred to enforcing more compliance. Under the scenario of an oil spill there was more often a preference (75%) for a SMP with more enforcement and authority, including authority to penalize violators as opposed to a SMP with more education. Under the scenarios of increased rates of tourism and coastal constructions, in only 14% and 21% of cases was there a preference for a SMP which carried more authority and enforced more compliance. Thus in the majority of the cases, when increased rates of tourism and coastal construction were the scenarios, a SMP with more education and communication with the people and visitors was preferred.

The relative importance of the different objectives also seemed influential in determining the preference for SMP with more education or more compliance. For example, those stakeholders placing greater than half the relative value of objectives upon "ecological sustainability" preferred a marine park which encouraged more compliance in more than half the cases analyzed. Further, the relative importance that the chair of SCF and manager of SMP placed on lower level objectives was also influential. The preference of the former was more towards increasing education (in 3/4 scenarios) and the latter more towards stricter enforcement (in 4/4 scenarios). As these provided the base models for the analyses, their preferences were reflected in the results to some degree when imposing other stakeholder preferences at the higher levels.

Figure 4A. Relative value of alternative management strategies to stakeholders: status quo scenario

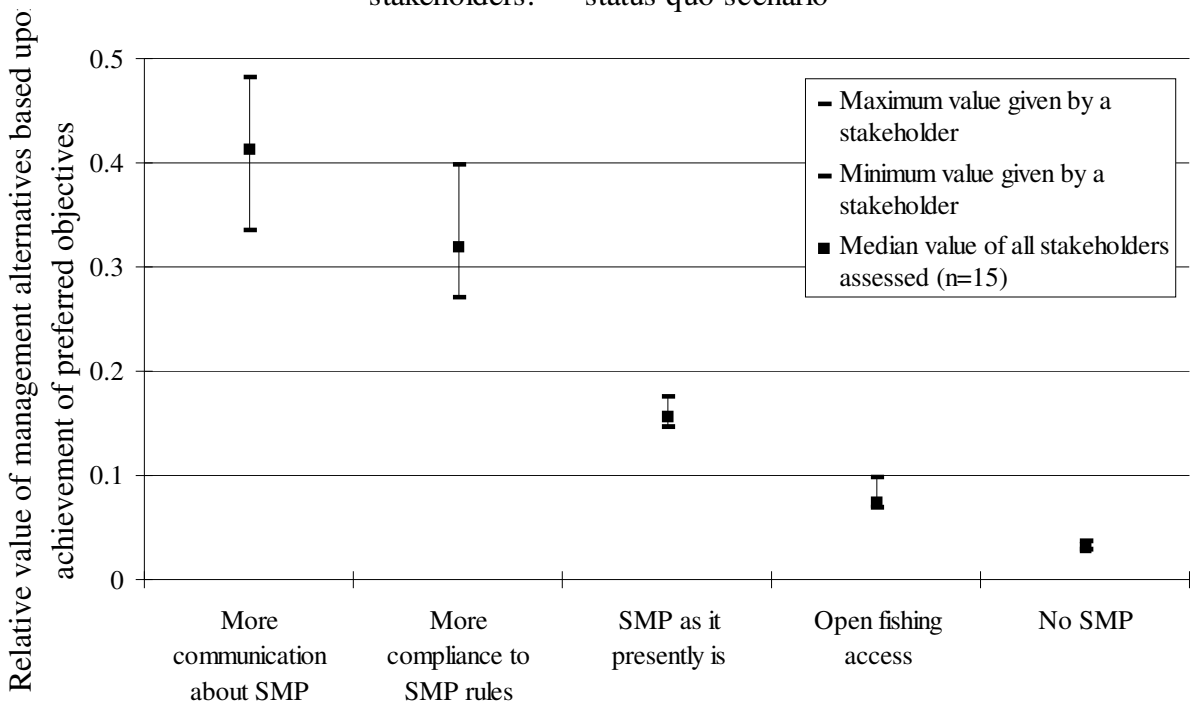


Figure 4B. Relative value of alternative management strategies to stakeholders: oil spill scenario

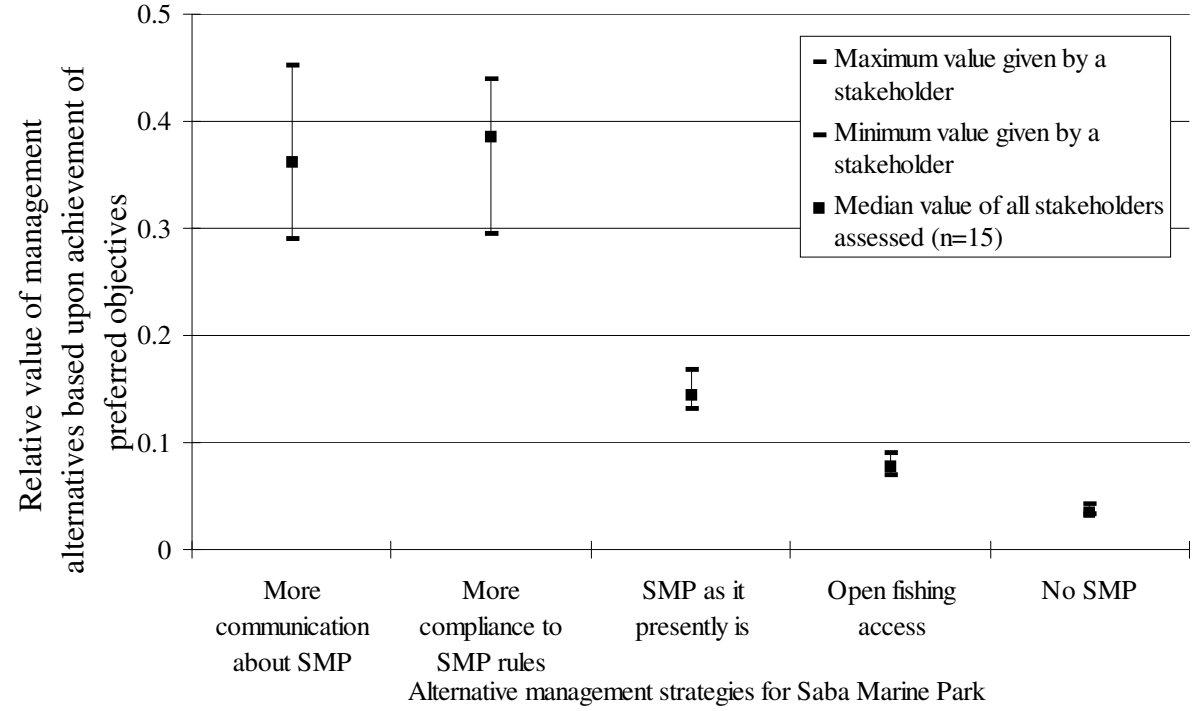


Figure 4C. Relative value of alternative management strategies to stakeholders: increased rate of tourism scenario

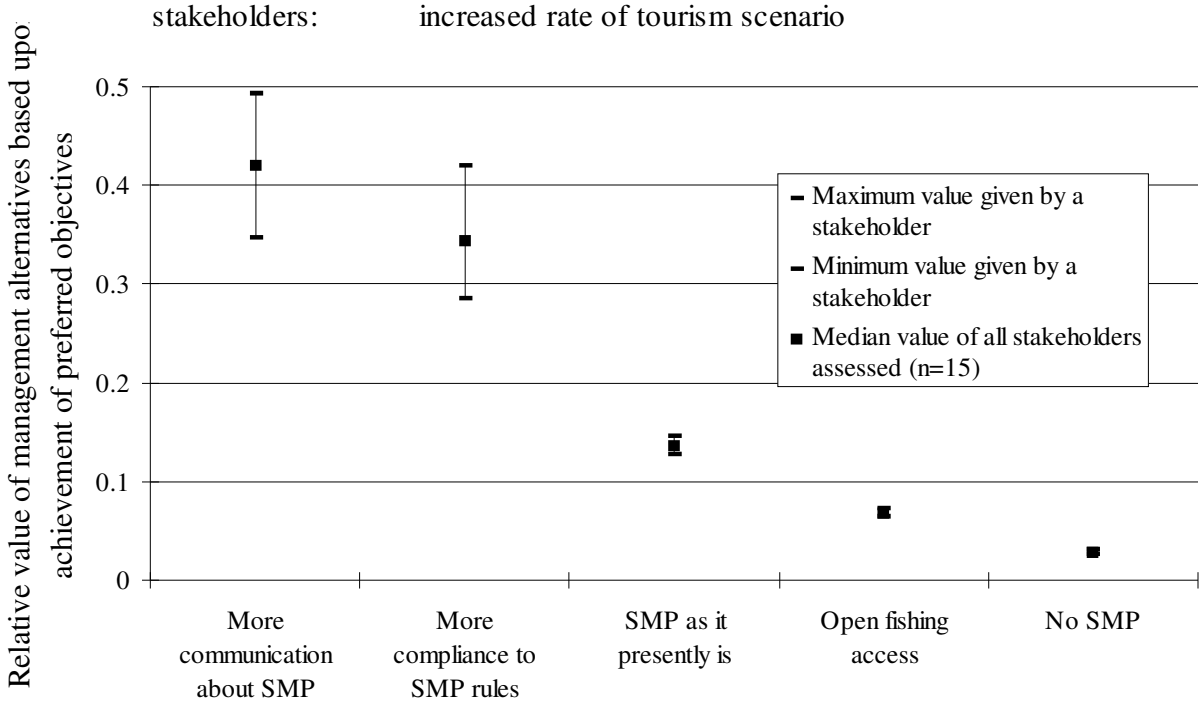
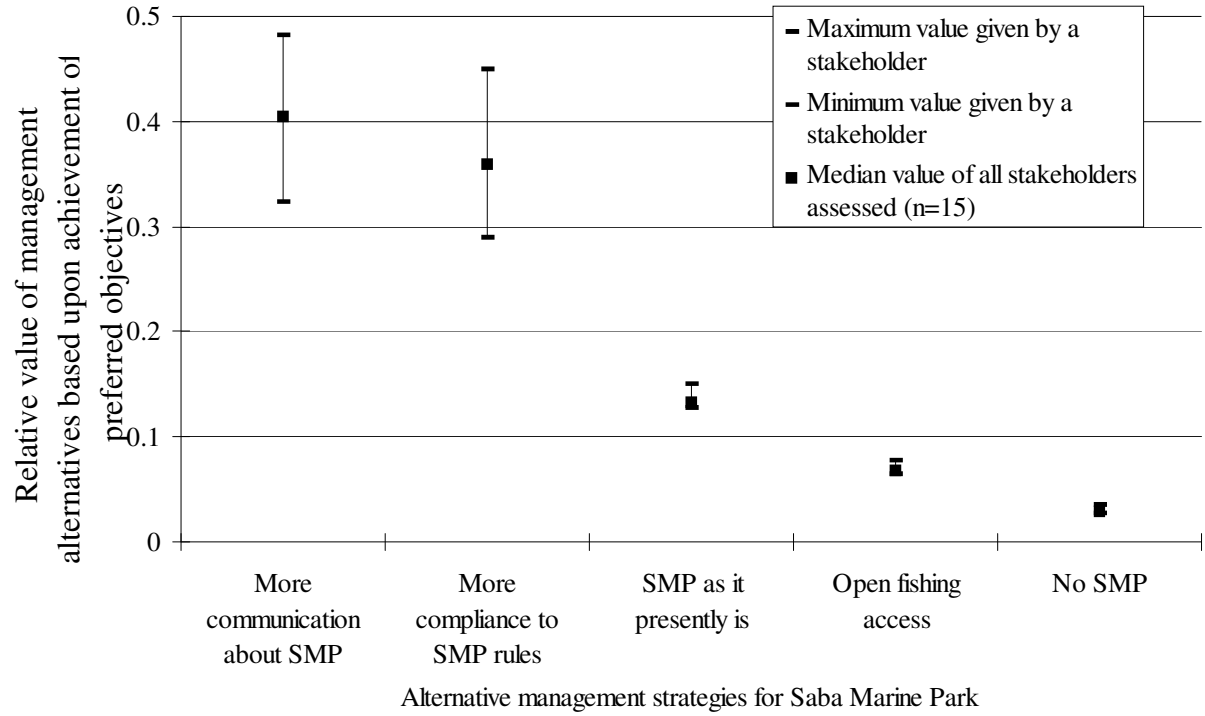


Figure 4D. Relative value of alternative management strategies to stakeholders: coastal construction scenario



Saba's diving visitors

The Saban community desires to derive some economic benefit from the environmental protection their marine park offers. A large component of the economic benefit of protection lies in the money spent by visiting SCUBA divers. To this end, it is important that future management actions of the Park do not endanger the economic benefits derived from these visitors. Three surveys conducted by myself and by Susan Walker indicate that 83% of divers return in part due to the knowledge that SMP will protect the marine environment (n=95) and 100% of the divers visit to experience some aspect of the diving which can be directly attributed to SMP management (n=147) (White and Fernandes unpublished data, Fernandes 1995). All of the divers surveyed by the author agree that SMP should concentrate primarily on environmental protection (n=95) and all questioned were happy to pay the diver fee (US$2.00) to help towards that effort (n=20). Most of the visiting divers come to enjoy uncrowded diving (93%) and many mentioned the desire of minimizing diver damage and installing a diver carrying capacity (13%). For these reasons, increasing education activities, introducing stricter controls on SMP use by divers or introduction of a diver carrying capacity of some type are unlikely to deter diver tourists from visiting the island.

DISCUSSION

Implications

There was much agreement between stakeholders preferences in which future management alternative is most desirable and the high value of having Saba Marine Park (SMP)(Figure 4). This agreement seemed true despite the wide range of opinions as to which objectives are most important for SMP. The current work provided a forum for extracting and discussing the various concerns of the community and allowed the surprising degree of general agreement to become apparent. This common ground amongst areas of disagreement should provide a basis of support for SMP as it moves towards meeting community needs and desires.

There was concurrence, for example, that the present SMP is far more valuable to Saba than no marine park or a park which permits line fishing everywhere. If Saba does not continue having a marine park, then there will be negative consequences for the island economically, socially and environmentally (Results p.20). The benefits of maintaining SMP are, thus, multifaceted and can be enhanced by increasing efforts in some combination of education, communication and increasing park authority and regulation activities.

These results together with the detailed suggestions provided by the community members of Saba (Appendix F) can be, and are being, used by Saba Marine Park to increase their multidimensional value to the island. They can adopt community recommendations which require no legislative change and which lie within feasible logistical and financial constraints. A possible example of this might be facilitation of a greater marine education component in the schools. Adopting such community recommendations may lead to a re-emphasis of those SMP objectives which the people of Saba indicated are of greater importance.

Saba Conservation Foundation (SCF), the non-government administrative body in charge of the SMP, receives annual reports on the progress and changes within the marine park and is involved with hiring and firing decisions. In line with the findings here and the suggestions of local people, they could encourage dissemination of information on reported progress and changes to the Saban public and continue to encourage employment of qualified local people within the marine park (currently two of the three employees are Saban).

The Executive Council and Island Council retain overall responsibility for legislation and permitting with regard to the SMP. They, for example, created the legislative basis for the park (Marine Environment Ordinance, MEO, 1987). They can also influence the degree to which the marine park can fulfill the community objectives for the management of Saba's marine resources. They have made moves in the past to increase the value of the park to Saba. For example, they approved addenda to the MEO which allowed stricter control over visiting vessels and provides certain staff of the SMP with Special Law Enforcement Authority (approved recommendations 18 Aug. 1993 and 25 Aug. 1994 respectively). This report provides information on the wishes and desires of the Councils' constituencies with regard to management of Saba's marine environment. As such, it could be used to inform government decisions which may influence the marine resources of Saba in general and the SMP in particular.

Limitations

This work was aimed towards providing information to support decisions regarding the SMP and, in support of that, establishing an estimate of the value of the current SMP. These aims were fulfilled without conducting a truly representative sample of the community. Representative sampling was unnecessary as the purpose of the work was decision support not sociological profiling of the community. For the situation explored on Saba the decision makers desired some idea of the direction and limits of the community opinions not an exhaustive detail of every type of opinion held by every person with or without interest in or knowledge of the SMP. A representative sample of Saba would have been impracticable as it would require stratification of the community into social, economic, racial, residential, occupational as well as stakeholder groups. This, in turn, would have required collection of data which presently not available and then random sampling of groups which would have been far more time consuming and expensive. For these reasons, extrapolation of the results to represent an accurate sociological profile of the Saban community is not possible. Despite the limited sampling regime, the analysis has strength in that such a large percentage of the population was interviewed. Further, the author received extremely few new and popular opinions or ideas beyond the first 30 interviews. The work does, therefore, describe the opinions of extremely various components within the community and in this way attempts to define some boundaries of Saban community views.

Of the main decision makers involved only the chairperson of SCF and the manager of the SMP provided preferences as to objectives and management alternatives throughout the whole hierarchy. All participants questioned agreed that their views would be sufficiently represented at the lower levels within the objectives hierarchy by the preferences expressed by Mr. van't Hof and Mr. Buchan. Despite this claim, it is likely that the results may have differed if the other decision makers had chosen to prioritize the complete objectives hierarchy.

The analysis is also based upon preferences and opinions solicited at one point in time. As participants in the analysis gather more information and reconsider their perspectives their opinions, can and often do, change. For example, the manager of SMP now considers that he should have placed slightly more emphasis upon the SMP objective of managing the marine environment in a socially acceptable manner and slightly less upon ecological sustainability.

There may have been a bias in the views elicited from visiting divers as they were sampled from the address list of the "Friends of the Saba Conservation Foundation". These people are more likely to be conservation oriented and more likely to care about Saba and her marine resources than other divers.

The aim of this work was not to provide a mathematically optimal solution to the successful achievement of the community identified objectives. The solution lies either in further analysis using optimization techniques (Cohon 1978, Goicoechea et al 1982) or considered judgment over the suggested management actions and experience based selection of those most able to achieve the community designated objectives of SMP.

Future research

The analysis could also be geared specifically to explore the impact of Council decisions on the community identified objectives of the SMP. It is in the hands of the Executive and Island councils to decide, for example, on levels of tourism, coastal construction, development and infrastructure planning. Any of these decisions may cause positive or negative impacts on the value of Saba's marine environment to the Saban community. The extent and degree of impacts may be estimated by the SMP which can act as advisor to the Executive and Island Councils. Appendix I illustrates the type of evaluation which could result from an exploration of the impact of various decision choices on achievement of community chosen objectives of the SMP. This preliminary exploration is not included in the main body of the text as it was not within the scope of the current research.

The analytical framework presented here can also be used as a monitoring tool for the SMP. This represents an extremely useful by-product of the current work which was not, originally, directed towards generating a monitoring tool. Attributes have been chosen by which to measure degree of achievement of all of the lowest level objectives of the SMP (Appendix D). The current (August 1994) status of SMP objectives has been estimated with regard to each of these attributes. Future estimates can be made and then compared to follow progress within the main ecological, social and economic objectives and to provide a weighed integrated measure of progress towards the overall goal (Appendix J).

Monitoring, as suggested here, includes a large qualitative component due to a lack of data. This is not a problem for this type of analysis. However, as more reliable or quantitative data become available they can be scaled along the existing measures and included in the framework to reduce the possibility of subjective inconsistencies.

An integrated monitoring tool can be limited by failing to trigger responses to an extremely poor status of one of the multiple objectives. For example, within one objectives hierarchy for SMP (Appendix J, Figure 7) maximizing fish abundance is given an overall weight of 0.042 within the overall hierarchy. If all fish within SMP decrease in abundance significantly this objective would not be achieved and a score of 0 out of 0.042 would be allocated. However, within the overall estimate of progress (on a scale of 0 to 1.00) this change may not be detected. Therefore, it might be desirable, in the future, to incorporate levels of attributes or indicators which indicate "safe minimum standards" or "limits of acceptable change" (Ciriacy-Wantrup 1952, Bishop 1978, Wilks 1993). Movement towards or beyond such thresholds can then be used to trigger responses in management actions or changes in priorities regardless of degree of progress towards the "overall" goal. For example then, a state where all fish are decreasing in abundance could be a limit of acceptable change and would trigger a response despite the fact that perhaps all other objectives are satisfactory.

GLOSSARY

alternatives - different decision choices available, in this case, various marine park management directions or strategies
attributes - parameters by which to measure the degree of achievement of lowest level objectives within a hierarchy (e.g. biomass of fish families can be used to measure achievement of improving fish stocks)
case - combination of a particular set of management alternatives, preferences and scenarios.
criteria - the object about which there is a preference for a given state (e.g. the fish stocks are the object for which the aim is to improve their condition)
goal - the overall aim inclusive of sub-components
objective - specific statements about desired states of different objects or dimensions relevant to the problem at hand (e.g. improve the condition of the fish stocks of Saba is an objective)
objectives hierarchy - an organization of objectives into a branched framework where "leaves" of a branch are lower level objectives
preferences - subjective statements by stakeholders of the relative desirability of multiple objectives. Preferences are the information upon which ratio scaled priorities for objectives are generated by the Analytic Hierarchy Process.
priorities - the calculated ratio scaled weights ascribed to multiple objectives based upon relative preferences different stakeholders have for different objectives
scenario - set of specified future conditions under which different management alternatives are tested
stakeholder - anyone who has a vested interest or stake in the outcome of the decision at hand including, for example, decision makers, user groups, conservation groups etc.
value tree - as "objectives hierarchy"

REFERENCES

Bishop, R.C. 1978. *Endangered species and uncertainty: The economics of a safe minimum standard*. Amer.J.Ag.Econ. 57:10-18.

Ciriacy-Wantrup, S.V. 1952. Resource conservation. Berkeley: University of California Press.

Cohon, J. 1978. Multiobjective programming and planning. New York: Academic Press.

Edwards, W. and J.R.Newman. 1982. Multiattribute evaluation. Beverly Hills: Sage.

Fallon-Scura, L. and T. van't Hof. 1993. Economic feasibility and ecological sustainability of the Bonaire Marine Park. Environment Department, Divisional Working Paper, The World Bank.

Fernandes, L. 1995. Response to diver surveys on the objectives of Saba Marine Park. Texas: Saba Conservation Foundation Newsletter (submitted)

Hawkins, J.P., C.M.Roberts and S.White. 1993. Effects of recreational SCUBA diving on a Caribbean coral reef. Coral Reefs (submitted??)

Goicoechea, A., D.Hansen and L.Duckstein. 1982. Multiobjective decision analysis with engineering and business applications. New York: John Wiley.

Hof, T.van't (ed.) 1993. Saba Conservation Foundation Annual Report 1993. Saba: Saba Conservation Foundation.

Hwang, C. and K.Yoon. 1981. Multiple attribute decision making: methods and applications. New York: Springer-Verlag.

Janssen, R. 1991. Multiobjective decision support for environmental problems. Amsterdam: Drukkerij Elinkwijk.

Janssen, R., P.Nijkamp and H.Voogd. 1984. *Environmental policy analysis: which method for which problem?* Revue d"Economie Regionale et Urbaine 5:839-855.

Joint Commission on the Integral Development of Saba and St. Eustatius. 1994. Report of the Joint Commission on the integral development of Saba and St. Eustatius. Saba: Joint Commission.

Mol, R. 1989. Doctor on Saba. Delft: Eburon.

Polunin, N.V.C. and C.M.Roberts. 1993. *Greater biomass and value of target coral reef fishes in two small Caribbean marine reserves*. M.E.P.S. 100:167-176.

Ridgley, M.A. and D.K. Chai. 1990. *Evaluating potential biotic benefits from conservation: anchialine ponds in Hawaii*. The Environmental Professional 12: 214-228.

Roberts, C.M. (in press). Rapid reef build up of fish biomass in a Caribbean marine reserve. Conservation Biology.

Saaty, T.L. 1982. Decision making for leaders. Belmont, CA: Lifetime Learning Publications.

Saaty, T.L. 1977. *A scaling method for priorities in hierarchical structures*. J.Math.Psych. 15:234-281.

Wilks, L. 1993. The carrying capacity concept and its application to the management of coastal zone resources. Canberra: Resource Assessment Commission Coastal zone Inquiry Information Paper No.8.

Zeleny, M. 1982. Multiple Criteria Decision Making. New York: McGraw-Hill.

APPENDIX A. Methodological procedure

Multiple criteria analytic techniques are many and varied, however, the procedure for addressing any problem situation is fairly standardized. The first phase of the analysis requires determination and structuring of the objectives of the project being considered:

Step 1. Define the problem or determine the reasons for the analysis.
A particular situation can only be improved if the purpose of the research is extremely clearly defined.

Step 2. Identify the stakeholders.
"Stakeholder(s)" describes any person, or group of persons, who has a stake or interest in the situation at hand, including the decision makers.

Step 3. Identify the objectives.
In bottom up analysis, the desired outcome of the problem situation can be summarized in objectives identified by the local community, other stakeholders including decision makers.

Step 4. Structure the objectives.
An objectives hierarchy (or value tree) is constructed to provide an overall view of all the relationships between the objectives at hand. This has a form similar to a family tree with major objectives being divided into smaller, more detailed objectives at a lower level in the tree.

Step 5. Choose attributes for lowest level objectives in the hierarchy.
Attributes are the yardsticks by which one can measure, or estimate, degree of achievement of different, lowest level objectives. These attributes may be quantitative or qualitative and provide a base upon which objectives can be normalized and compared to each other.

Step 6. Establish relative priorities for all the identified objectives.
Different constituencies within the community will place relatively different values on the various objectives. These differences can be explored by allowing each stakeholder group to prioritize the objectives.

The second component of the analysis involves evaluating different possible solutions or actions based on how well they achieve the objectives identified and prioritized in the first part of the work. Evaluations are conducted within different future scenarios:

Step 7. Define alternative solutions or types of actions.
The future actions taken could take different directions in an effort to maximize achievement of its objectives. In a bottom up analysis, these are defined using input from the stakeholders.

Step 8. Construct possible scenarios.
Possible future conditions under which the different solutions may need to operate are termed "scenarios" and include, for example, the status quo situation. These are used to determine the sensitivity of the chosen solutions to conditions outside of the control of the decision makers involved.

Step 9. Evaluate management alternatives with respect to achievement of objectives.
An evaluation of all the alternative solutions is conducted for each combination of objectives with particular priorities and within each defined scenario. For example, an evaluation may be conducted with respect to (a) achievement of a hierarchy of ecological and economic objectives in which (b) the economic objectives are twice as important as the ecological objectives and (c) a scenario of major global climate changes. In another

evaluation of the same alternative solutions and the same objectives, the scenario may be the same but the economic and ecological objectives are weighed differently, perhaps as being equally important. The value placed upon the various solutions by stakeholders is based on (a) the degree of achievement of objectives and (b) the relative importance of those objectives to the stakeholders. As the importance of various objectives varies, so may the preferred solution.

APPENDIX B. Interview questionnaires

Below is the semi-structured questionnaire used with stakeholders in discussing their desires regarding Saba Marine Park

1. a. What do you think should be the objectives in managing Saba's marine resources?
   b. Have you noticed any positive or negative impacts/changes on Saba due to SMP? Why have you noticed these impacts/changes?
   c. Have you noticed any conflicts associated with SMP?
   d. What impacts/changes/conflicts do you anticipate in the future with regard to SMP?

2. a. What do you think should be the main environmental objectives associated with managing Saba's marine resources?
   b. Have you noticed any positive of negative environmental changes associated with SMP?
   c. Do you anticipate any positive or negative environmental changes associated with SMP?

3. a. What do you think should be the main economic objectives associated with managing Saba's marine resources?
   b. Have you noticed any positive of negative economic changes associated with SMP?
   c. Do you anticipate any positive or negative economic changes associated with SMP?

4. a. What do you think should be the main social objectives associated with managing Saba's marine resources?
   b. Have you noticed any positive of negative social changes associated with SMP?
   c. Do you anticipate any positive or negative social changes associated with SMP?

5. Is there anything else you would like to say?

Below is the semi-structured questionnaire used in a written survey with SCUBA divers. The aim was to determine their opinions given the current SMP and the possibility of a change in SMP management direction.

1. When was the first time you came to Saba?
2. Did you come primarily to dive at that time?
3. Did the existence of SMP influence that original decision to come?
4. Did you come for any other reasons? _ Accompanying diver; _ Quaint island charm; _ Friendly people; _ Beautiful hikes/scenery above water; _ The peaceful atmosphere; _ Other.
5. How experienced a diver were you at that time? (approx. # dives)
6. How many times and when have you returned? _
7. For what reasons do you/would you return? _ Accompanying diver; _ Uncrowded diving; Wonderful diving; _ Knowing SMP will protect the marine environment; _ Quaint island charm; Friendly people; _ Beautiful hikes/scenery above water; _ The peaceful atmosphere; _ Other.
8. What do you think the main objectives of SMP should be? (You may not feel that the SMP should have objectives in all of the areas listed)
    - _ Environmental objectives (marine and/or terrestrial environment)
    - _ Social objectives (with regard to Sabans or visitors)
    - _ Economic objectives (for the area or the Park itself or Saba in general)
    - _ Political objectives
9. Which of these objectives do you think are most important overall?
    - _ Environmental objectives (marine and/or terrestrial environment)
    - _ Social objectives (with regard to Sabans or visitors)
    - _ Economic objectives (for the area or the Park itself or Saba in general)
    - _ Political objectives
10. which objectives do you think the SMP could address more fully?
    - _ Environmental objectives (marine and/or terrestrial environment)
    - _ Social objectives (with regard to Sabans or visitors)
    - _ Economic objectives (for the area or the Park itself or Saba in general)
    - _ Political objectives
11. What do you think are the main environmental, social or economic issues facing Saba in general and SMP in particular?

APPENDIX C. Issues discussed by the people of Saba.

This list provides an outline of topics which were brought up as important to the respondents in some way. The frequency that each issue was mentioned is given. These issues include objectives for Saba Marine Park which are being achieved or should be achieved; they also include suggestions as to how to achieve objectives, opinions, concerns and complaints. Note that some issues are not related to SMP but are included for completeness sake. A total of 48 Saban residents were interviewed and 33 school students wrote their opinions in response to the main questions outlined in Appendix B. The issues highlighted were mentioned at least once at a public meeting.

Environmental issues	Public	Students
Maintenance of ecosystems (protect fish and corals; keep waters clean; prevent pollution)	43	28
Carrying capacity	20	4
Anchor damage has decreased	15	10
Impact/diver has decreased via education	11	
Monitoring	10	
Patrolling/enforcement	13	
Excluding fishers/less fishing now	6/2	
Oil spills from Statia	8	
Expanding size/authority SMP with regard to future development	7	
Fish abundance	5	10
SMP came in before destroyed	5	
Prevent pollution from foreign vessels	4	
Sabans don't damage nature thus SMP protecting resources from visitors	4	
Excluding foreign fishing/diving boats	4	
Maintain the dive sites	4	
Fish abundance decreased/size increased	4	
Influencing the type of use	3	
Location of garbage dump	2	
Increased coral damage associated with more divers	2	
Protecting turtles, conch, coral	2	
Water quality	1	
Terrestrial runoff in general is a problem	1	
No environmental impact of SMP	1	
Moorings need to be kept up better	1	

Environmental issues	Public	Students
Provide example internationally of financially independent marine park	1	
Need to set up something with regard to cleaning boats	1	
Prevent removal of anything in SMP	1	
More moorings for fishers and divers	1	

Social issues	Public	Students
Education of local children	24	14
Communication/interactions with community	27	10
SMP attracts desirable type of visitor	21	
Minor conflict between SMP/users: dive operators; fishers	16	13
More support for SMP now especially from fishers (also as economic benefits become apparent)	16	
Better appreciation/understanding of marine resources via education	14	5
No conflict with fishers and SMP NOW	13	
No social impact SMP (Saban culture not being lost; no conflicts between SMP and Saban culture)	12	
Minor conflicts exist between users: recreational fishers and divers; yachties and divers	10	
Local access to resources	9	
Sabans not interested/don't know about SMP	9	
More visitors leads to more foreign investors or foreign workers which leads to more social impact	6	
Dive operators co-operate with SMP	6	3
Perhaps illegal fishing (locals and/or foreigners)	6	
Limit visitation	5	
SMP helps to avoid social conflict by mediating	4	
SMP makes decisions WITH stakeholders	4	
Government, SMP, dive operators and tourist office should co-operate	3	
Saban culture being lost	3	
Consider artificial reefs/float systems for fishers	1	
Allow spectrum of human uses	1	
Approval of user pays	1	
International identity associated with SMP gives pride	1	

APPENDIX C. Issues discussed by the people of Saba.

Social issues	Public	Students
Due to SMP, Sabans have opportunity to broaden their outlook	1	
Fishers think more about fish resources and impacts	1	
Perhaps should increase area of SMP to protect turtles better	1	

Economic issues	Public	Students
Increased development on Saba is associated with diver tourists and yachts which are associated with SMP	37	11
SMP is financially independent	11	
People engaged in better paying jobs	9	
More visitors leads to increased foreign investment and interest thus pressure to develop	5	
Standard of living has increased	4	
Want more yachts coming in	2	
Little benefit of live aboard dive boats or yachts	1	
Other options for commercial use of SMP	1	
Objective of SMP is to attract tourists	1	
Cost of living increased	1	
SMP must be accountable for funds received	1	
SMP should generate more money	1	
Need to establish eco-tourism niche	1	
Greater reliance on imports now	1	
Need to maintain options for future use	1	
Chamber is part of SMP's influence in attracting divers	1	

Political issues	Public	Students
Want SMP to provide advice to government regarding adjacent terrestrial developments	14	
Need government communication re:SMP	4	
Need to remain politically neutral	1	
SMP enforcing politically approved laws	1	

Other (including non-SMP issues)	Public	Students
Want better distribution of economic benefits and jobs	13	
Need terrestrial version of SMP	9	
Economic benefits are shared	6	
"Unspoiled" aura of Saba an attraction too	3	
Limit economic growth	3	
Personnel in SMP a problem	2	
Caribbean Explorer is bad advertising	2	
SMP should plan ahead	1	
Give Sabans preference in development efforts	1	
Give locals jobs in SMP	1	
Offers opportunities for scientific research	1	
Loyal clientele of visitors	1	
Goats	1	
More local handicrafts should be made	1	
Terrestrially Saba is less clean than before	1	
Government thinks 50,000 tourists/yr good	1	
For SMP to do better job need more people	1	
SMP not assisted with Saba Bank	1	
SMP just interested in the money	1	
Used to make jewelry from black coral	1	
Not enough young people willing and able to get into tourist trade	1	
Sometimes the community voices its opinion and the government doesn't listen - same here?	1	

APPENDIX D. Attributes chosen for measuring achievement of objectives

Attributes are described here which can be used to measure degree of achievement of desired SMP objectives. The attribute need not be perfectly measurable but may only be an index or estimated measure. Normalization refers to scaling the attributes to a 0 to 1.0 scale where 0 is undesirable and 1.0 is desirable.

OBJECTIVE: Minimize reef damage.
ATTRIBUTE: Physically damaged coral.
% of colonies recorded which are broken or abraded. Use the average damage at all heavily dived areas. "Heavily dived" is define as per Hawkins et al 1993.
NORMALIZE: 0 = too much damage (to be assessed by SMP and SCF as changes are monitored); 1.0 = 2.4% of colonies which was recorded in the "low use" areas of Saba. Presently, 2.8% colonies are damaged which is close enough to desired level. For reference, in Egypt in heavily dived areas 9.3% colonies are damaged and Hawkins et al (1993) considers this at or above carrying capacity. Using that reference the coral damage could be considered to be at 0.95 of the desirable level.

OBJECTIVE: Maximize fish stocks.
ATTRIBUTE: Increases in biomass of five fish families over time. (from Polunin and Roberts 1993, Roberts in press). Problems measuring this objective may arise when biomass of fish stocks stabilize.
NORMALIZE: If all fish families increase in biomass = desirable (ideal) situation; if all five families decrease in biomass = undesirable situation; middle = no change. Presently 3 groups increased in biomass which sets the level at 0.8.

OBJECTIVE: Maximize water quality.
ATTRIBUTE: 4 types pollution: oil; nutrient enrichment; human induced sedimentation; garbage (excluding oil, nutrients, sediments etc.). Estimates by SMP and SCF as to the amount of pollution attributable to each type.
NORMALIZE: Each type of pollution gets a score out of 1/4. 0 = undesirable condition; 0.125 = a problem but still O.K.; 0.25 = almost no pollution, desirable situation. Measured values can be applied to these verbal assessments as data become available. Presently oil=0.125; nutrient enrichment=0.25; sediment=0; garbage=0.125 thus TOTAL=0.5.

OBJECTIVE: Contribute positively to the income of the Saban community.
ATTRIBUTE: Amount of spending by divers (who come here in part due to one or more of the following reasons: protection of environment, pristine environment, abundance and variety of fish, variety of size of fish, low damage etc. = all influenced by existence of SMP)(White and Fernandes, unpublished data).
NORMALIZE: Undesirable is less than current level; desirable is current level and everything above. Currently spending is at roughly greater than US$1.5 million.

OBJECTIVE: Increase children's understanding of marine environment and SMP.
ATTRIBUTE: Number of lessons/year which include marine environment or SMP.
NORMALIZE: Undesirable is zero; desirable is once/week; presently the high school students get 3-5 lessons per year; Grades 1-3 get 5-10 classes per year and Grades 4-6 get about 5 lessons on the marine environment per year. This averages at roughly 5 lessons of a desirable 40 per year. The present level is too low at 0.125.

OBJECTIVE: Increase public appreciation of marine environment and SMP.
ATTRIBUTE: Number of exposures/year (type of media does not matter).
NORMALIZE: Undesirable zero; desirable is 12/year; currently at approximately 6 exposures/year. The present level is too low at 0.5 of desired level.

OBJECTIVE: Increase government awareness of marine environmental impacts and SMP.
ATTRIBUTE: Degree of satisfaction felt by SMP and SCF with regard to communication with government on decisions which could impact the marine environment.
NORMALIZE: Scale: 1.0 = extremely satisfied with amount of input; satisfied with amount input = 0.75; not particularly satisfied or dissatisfied with input = 0.5; dissatisfied with amount of input = 0.25; extremely dissatisfied = 0. Present opinion is that SMP is between being satisfied and not particularly satisfied with amount of input = 0.625.

OBJECTIVE: Minimizing conflicts of access and interest between users.
ATTRIBUTE: Assessment of SMP manager regarding amount of conflict (based on complaints, warnings and information passed on informally).
NORMALIZE: A very low level of conflict is ideal = 1.0; some level of conflict which doesn't constitute a real problem = 0.75; a level of conflict which is bordering on becoming a problem =0.5; some conflicts which constitute a problem = 0.25; a lot of problems with conflict = 0. Present level is about 0.75 according to annual report 1993 "...relatively few law enforcement problems" and "a number of complaints....".

OBJECTIVE: Global education about marine biology and management with SMP as a model.
ATTRIBUTE: Assessment by SMP and SCF about degree of satisfaction with two components: degree of hands on education and exposure as example in books for education.
NORMALIZE: For each component contribute 0.5 to total: 0=no input to global education; 0.125 = not satisfactory input to global education; 0.25 = o.k.; 0.375 = pretty good level of input but can be improved; 0.5 = ideal amount of input. For hands on presently not satisfied; for exposure in texts pretty good thus TOTAL = 0.5.

OBJECTIVE: Global scientific research about marine biology and management with SMP as a model.
ATTRIBUTE: Assessment by SMP and SCF about how satisfactory the current level of research is.
NORMALIZE: As with "global education" but only one component. Presently at pretty good = 0.75.

APPENDIX E. Priorities for identified objectives as expressed by Saba Conservation Foundation and SMP.

Figure 5. Community derived objectives hierarchy for Saba Marine Park (SMP) prioritized according to the preferences of the chair of the Saba Conservation Foundation (SCF). Numbers in parentheses representing weightings given to each objective which reflect the chairperson's opinion as to their relative importance to achieving the higher level objectives. Under each lowest level objective are the different management alternatives defined in Step 7. How well each alternative can achieve each objective will provide the basis for the evaluations in Step 9. Legend is as in Figure 2 and on next page.

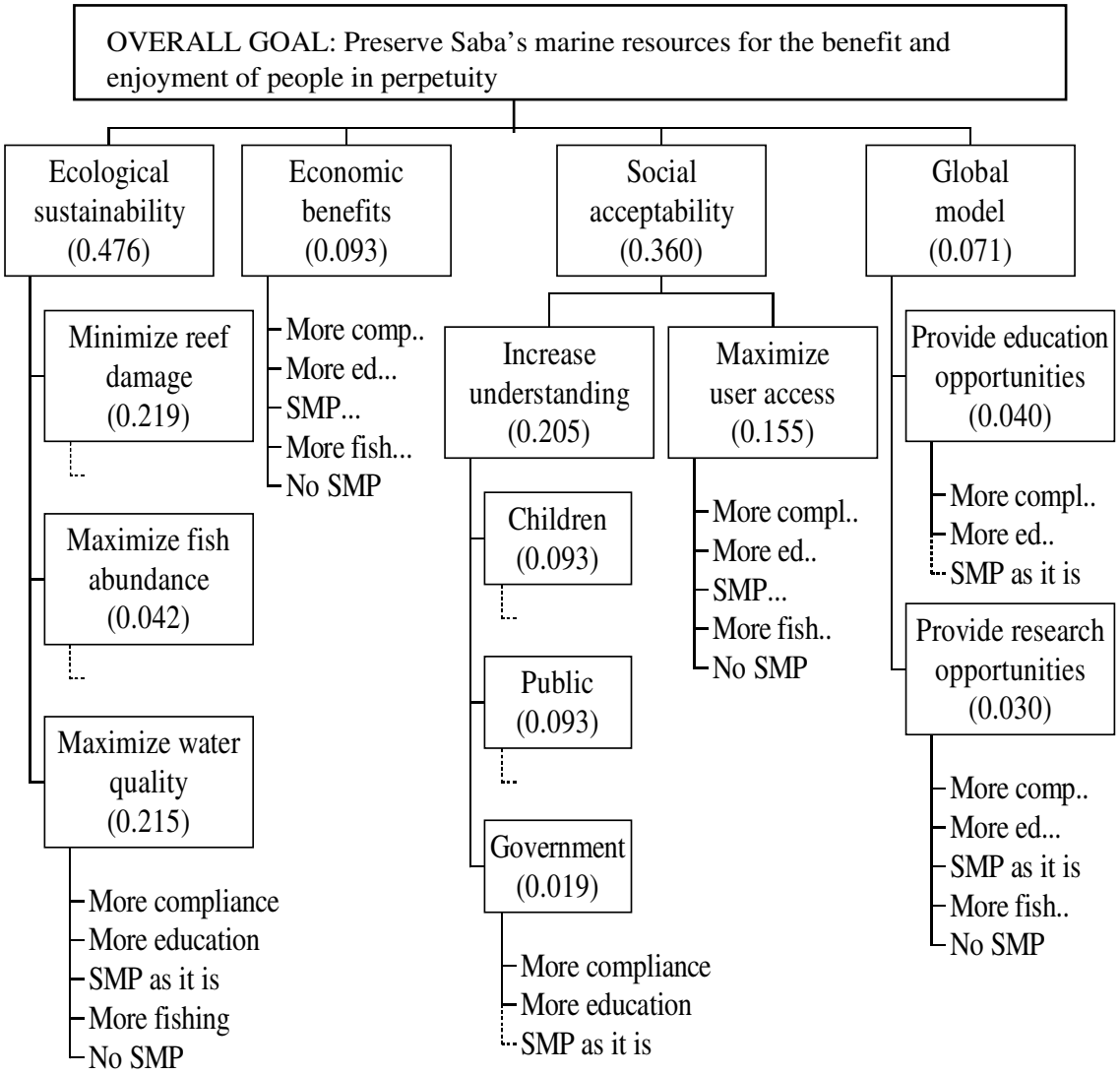
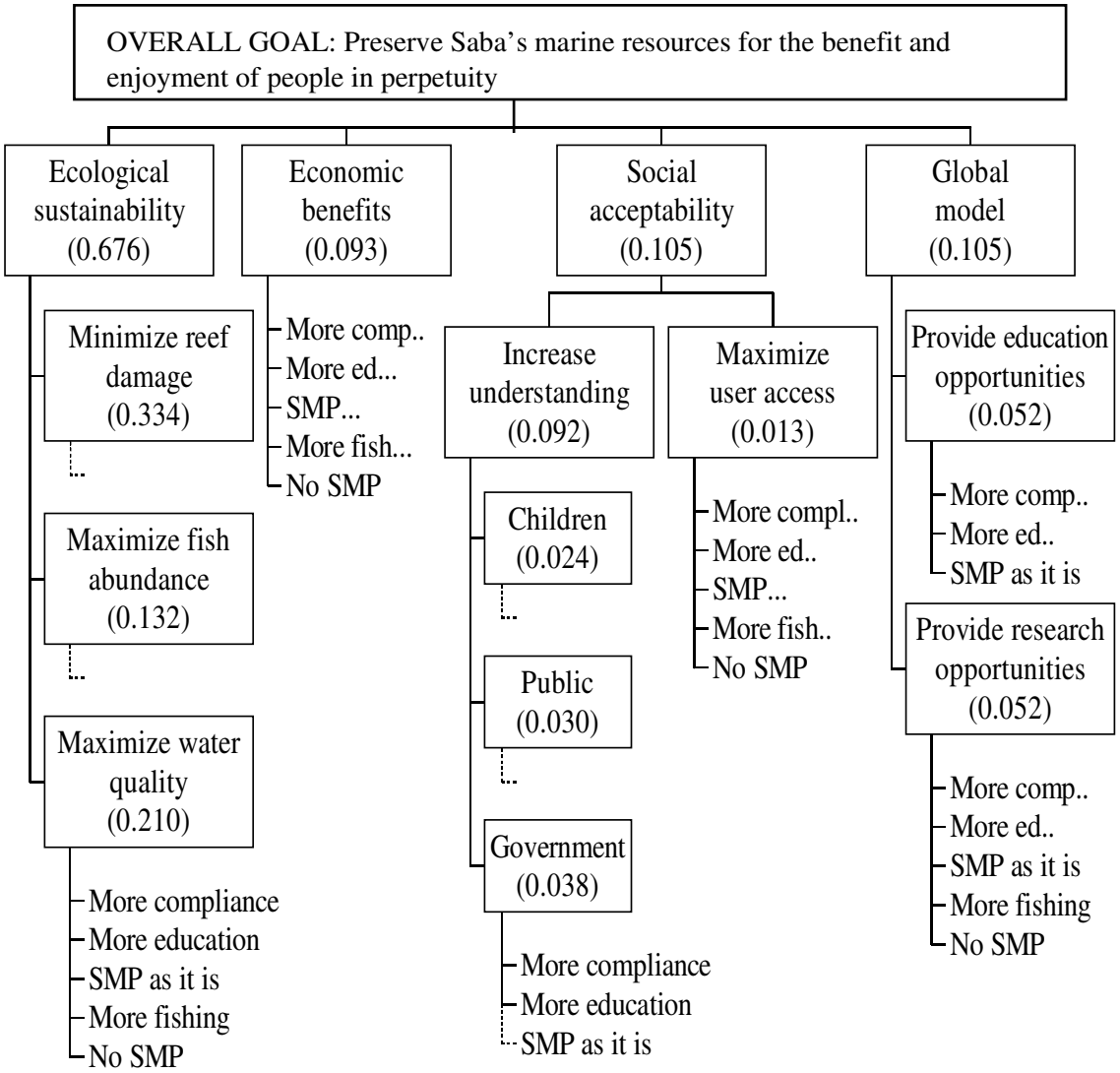


Figure 6. Community derived objectives hierarchy for Saba Marine Park (SMP) prioritized according to the preferences of the manager of the Saba Marine Park (SMP). Numbers in parentheses representing weightings given to each objective which reflect the manager's opinion as to their relative importance to achieving the higher level objectives. Under each lowest level objective are the different management alternatives defined in Step 7. How well each alternative can achieve each objective will provide the basis for the evaluations in Step 9. Legend is as in Figure 2 and on next page.



APPENDIX E. Priorities for identified objectives as expressed by Saba Conservation Foundation and SMP.

Legend to Appendix E.

Abbreviated name of alternative management directions: explanation of management alternative

No Saba Marine Park (SMP): SMP ceases to exist
More fishing: the "No fishing" zone is eliminated from SMP which remains otherwise as it currently is
SMP as it is: SMP as it presently functions with no changes
More compliance: SMP as it presently functions with increased enforcement to encourage compliance and increased authority to prevent damage and overuse.
More education: SMP as it presently functions with increased education, communication and interaction with all components of the Saban community

APPENDIX F. Alternative future management directions for SMP.

Management alternatives evaluated in this analysis.

1. **SMP as currently is**

2. **No SMP**

3. **Open access**

An open access SMP refers to the elimination of no fishing zone.

4. **SMP as it is with more education** - meaning more communication, interaction, education and involvement with Saban community.
Below are specific actions which have been recommended.

Schools

- Communicate with educators as to how more marine education can be included in curriculum e.g. include marine environment topics or examples into established geography, english, dutch, science, social science lessons.
- Support school "field trips" to SMP. Perhaps build a glass box to enable viewing underwater from a boat.
- Initiate swimming/snorkeling lessons.
- Initiate/facilitate scuba diving as part of school sports or as extra-curricular activity (working together with dive shops).
- Inform educators/children of the types of jobs available in the marine environment (specifically Saba's marine environment) and education/training required for these.
- Require researchers with the SMP to make themselves available to the schools to teach a lesson/give a talk.
- Volunteer program for high school kids over the summer; involvement in water quality measures.

Community

- More interactions via various media: newspapers, radio, TV, intermittent one page newsletters, public meetings.
- Sponsor events to heighten awareness of marine environment and SMP e.g. drawing competition for children, special marine environment book week.
- Require researchers with SMP to write and send out press releases on their work (emphasizing the benefit to the Saban community).
- Sponsor activities with children that require parents' attendance/involvement e.g. swimming lessons, swim carnival, snorkeling lessons.
- Co-ordinate with fishers on putting in moorings for fishing in "All purpose" or "Multiple use" zones.
- Share information which could be of use to local businesses e.g. provide information on SMP to give to customers; provide information on trends and fluctuations in dive numbers; communicate on plans to establish carrying capacity in SMP.
- Invite Sabans to attend the Tuesday night slide show.

- Organize volunteer emergency oil spill recovery team.
- Let dive shops know that SMP appreciates their assistance.

Government

- Ensure positive information on SMP reaches government (e.g. international acclaim, improvements in the environment, economic benefits of SMP).
- Continue to advise government on environmental impacts of development proposals.
- Communicate with government on carrying capacity for SMP with regard to government planning (Also with regard to possible desire on their part to institute a social carrying capacity).
- Advocate integrated long term planning for Saba's development (discuss eco-tourism market niche and requirements of attendant types of tourists).

Introduce a diver operators training program aimed at teaching them to teach their divers about the marine environment.

5. **SMP as it is with more enforcement and authority**

This management alternative might include the following actions:

- Institute a diver carrying capacity in SMP.
- Patrol more often and irregularly, perhaps also at dawn/dusk and outside office hours.
- Be stricter with the rules e.g. give just one warning before fining offenders; inform locals that they will have no more warnings.
- Introduce rules or legislation regarding:
  cleaning of boats in SMP.
  requirement of environmental impact input from SMP re: coastal developments e.g. legally define coastal zone; e.g. legal arrangement where developers finance an Environmental Impact Statement through the SMP. The researcher conducting the EIS is selected by and responsible to the SMP (not the developer); e.g. institution of an environmental bond for protection against potential environmental damages (see Great Barrier Reef Marine Park Authority legislation).
  preventing human induced silt/sediment flow into SMP.
- Re-emphasis/check whether SMP rules are being conveyed to divers.
- Gain law enforcement authority for SMP staff.
- Introduce financial incentives to deter catastrophes e.g. from Statius oil terminal.

APPENDIX G. Stakeholders relative values for SMP management alternatives.

In this appendix are the relative value of future Saba Marine Park management alternatives based on the degree of achievement of stakeholder prioritized, community defined objectives. Results presented are derived from the Analytic Hierarchy Process. Evaluation of management alternatives using stakeholder priorities which included a Maximum or Minimum value for top level SMP objectives (as given in Table 3) produced the most extreme results. The most extreme results are presented here. That is, if particular priorities led to the highest of lowest value for any management alternative then these results are presented. Relative distribution of lower level priorities of SMP objectives are as elicited from the manager of the SMP (m) or the chair of the SCF (c) (Appendix E).

Table 4.A. Relative preference of future management alternatives under a **status quo scenario**. The most extreme preferences of the decision makers are presented in the top portion of the table and those from other stakeholders in the lower portion. (m) indicates that the lower level of the objectives hierarchy was prioritized by the SMP manager and (c) the Saba Conservation Foundation chairperson. as in Appendix E.

Stakeholder group	Different Management Alternatives *				
	More education	More compliance	Current SMP	More fishing	No SMP
E.C. 1 (m)	.368	.331	.171	.095	.036
E.C. 2 (c)	.448	.293	.156	.072	.031
SCF (c)	.458	.296	.146	.070	.029
SMP (m)	.342	.399	.154	.075	.029
Developer (m)	.352	.337	.176	.099	.037
Dive shop (m)	.345	.399	.153	.074	.029
Educator (m)	.335	.391	.161	.081	.031
Politician (c)	.483	.271	.147	.069	.030

* See Appendix F for detailed description of management alternatives.

Table 4.B. Relative preference of future management alternatives under a **serious oil spill scenario**. Otherwise the table is as described in Table 4.A.

Stakeholder group	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
E.C. 1 (m)	.316	.390	.164	.088	.041
E.C. 2 (m)	.371	.362	.149	.081	.036
E.C. 1 (c)	.317	.424	.145	.075	.039
E.C. 2 (c)	.373	.380	.138	.073	.035
SCF (c)	.373	.384	.135	.075	.034
SMP (m)	.313	.427	.147	.078	.034
Developer (m)	.290	.408	.168	.091	.043
Educator (c)	.302	.440	.143	.079	.037
Politician (c)	.433	.333	.131	.070	.033
Politician (m)	.453	.295	.144	.075	.033

Table 4.C. Relative preference of future management alternatives under a **scenario of a major increase in tourism**. Otherwise the table is as described in Table 4.A.

Stakeholder group	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
E.C. 1 (m)	.391	.362	.144	.073	.029
E.C. 2 (c)	.459	.312	.133	.068	.029
SCF (c)	.462	.314	.129	.067	.028
SMP (m)	.350	.421	.139	.064	.027
Developer (c)	.412	.346	.140	.071	.031
Developer (m)	.377	.373	.146	.074	.030
Dive shop (m)	.353	.418	.138	.064	.027
Educator (c)	.419	.346	.134	.077	.029
Educator (m)	.348	.418	.141	.066	.028
Politician (c)	.494	.286	.128	.065	.028

Table 4.D. Relative preference of future management alternatives under a **scenario of a major coastal construction**. Otherwise the table is as described in Table 4.A.

Stakeholder group	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
E.C. 1 (m)	.349	.413	.134	.072	.032
E.C. 1 (c)	.405	.337	.147	.077	.035
E.C. 2 (m)	.395	.377	.131	.068	.029
E.C. 2 (c)	.447	.319	.135	.070	.030
SCF (c)	.451	.327	.128	.067	.027
SMP (m)	.333	.446	.129	.065	.027
Developer (c)	.394	.342	.150	.078	.036
Dive shop (m)	.335	.445	.128	.064	.027
Educator (m)	.323	.450	.131	.067	.029
Politician (c)	.482	.289	.131	.068	.029

APPENDIX H. Relative preferences for SMP management alternatives for each of the main objectives.

In this appendix are relative preferences of Saba Marine Park future management alternatives when maximizing achievement of the main sub-objectives within the objectives hierarchy.

Table 5.A. Relative preference of management alternatives when trying to maximize **environmental quality and ecological sustainability**. Priorities of SMP objective hierarchy are as elicited from the manager of the SMP (m) or the chair of the SCF (c) (Appendix E).

Scenarios	Different Management Alternatives *				
	More education	More compliance	Current SMP	More fishing	No SMP
Status quo (c)	.414	.343	.144	.072	.027
Status quo (m)	.287	.469	.150	.067	.027
Oil spill (c)	.266	.474	.141	.085	.034
Oil spill (m)	.272	.478	.144	.074	.032
Increase in tourism (c)	.406	.365	.129	.072	.028
Increase in tourism (m)	.293	.485	.137	.059	.025
Coastal construct'n (c)	.394	.395	.122	.064	.024
Coastal construct'n (m)	.283	.504	.127	.061	.025

* These are described in detail in Appendix F.

Table 5.B. Relative preference of management alternatives when trying to maximize **economic benefits of SMP to community**. The rest of the Table is as detailed for Table 5.A.

Scenarios	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
Status quo (c)	.339	.339	.200	.082	.040
Status quo (m)	.322	.306	.201	.126	.045
Oil spill (c)	.247	.473	.157	.075	.047
Oil spill (m)	.228	.420	.192	.106	.054
Increase in tourism (c)	.371	.371	.151	.074	.034
Increase in tourism (m)	.370	.358	.154	.085	.032
Coastal construct'n (c)	.346	.346	.173	.091	.045
Coastal construct'n (m)	.293	.443	.143	.083	.038

Table 5.C. Relative preference of management alternatives when trying to maximize **social acceptability and understanding of SMP management**. The rest of the Table is as detailed for Table 5.A.

Scenarios	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
Status quo (c)	.537	.236	.132	.065	.029
Status quo (m)	.568	.205	.133	.067	.027
Oil spill (c)	.522	.262	.121	.065	.029
Oil spill (m)	.568	.205	.133	.067	.027
Increase in tourism (c)	.548	.244	.121	.060	.026
Increase in tourism (m)	.566	.208	.131	.068	.027
Coastal construct'n (c)	.539	.246	.124	.065	.027
Coastal construct'n (m)	.550	.235	.123	.065	.027

APPENDIX H. Relative preferences for SMP management alternatives for each of the main objectives.

Table 5.D. Relative preference of management alternatives when trying to maximize **the global opportunity for learning using the SMP as a model for research and education**. The rest of the Table is as detailed for Table 5.A.

Scenarios	Different Management Alternatives				
	More education	More compliance	Current SMP	More fishing	No SMP
Status quo (c)	.503	.234	.163	.068	.033
Status quo (m)	.498	.246	.154	.074	.028
Oil spill (c)	.492	.278	.136	.062	.033
Oil spill (m)	.418	.331	.132	.083	.035
Increase in tourism (c)	.526	.250	.134	.063	.027
Increase in tourism (m)	.483	.285	.135	.065	.032
Coastal construct'n (c)	.521	.262	.125	.062	.030
Coastal construct'n (m)	.482	.287	.135	.068	.028

APPENDIX I. Effect on SMP objectives of hypothetical Council decisions.

Introduction

Decision by the Executive and/or Island Councils of Saba are important and often far reaching. There is some possibility of repercussions of government decisions on the objectives the community has indicated are desirable in management of Saban marine resources. Such decisions are outside the control of the SMP however may impact the degree to which they can achieve their objectives. Possible impacts of government decisions on SMP objectives are briefly explored here.

Methods

The analytical methods used were as outlined above and the objectives hierarchy generated for the SMP based on community opinions is adopted. The management alternatives are changed to accommodate decisions pertaining to the Councils rather than pertaining to the SMP. For the Saban government, future decisions they face which may impact Saba's marine resources include alternative levels of tourism and various coastal constructions (Table 6). Here, the author introduces different amounts and types of tourists and construction as hypothetical decision alternatives. These replace the "management alternatives" in the SMP objectives hierarchy (Figure 2). Increases in visitors are assumed to be accompanied by increasing demands on goods and services on Saba as well as increasing demands on infrastructure. Two analyses are conducted - one considering tourism alternatives, one considering construction alternatives.

Table 6. Possible government decision alternatives considered.

Tourism alternatives	Definition of tourism alternative
Current	Tourism is maintained at current levels
10%	Tourism increase approximately at the present rate (leads to approx. 60 000 tourists/yr in 10 years time)
20%	Increases in the present type of tourists is encouraged and expanded (approx. 142000 tourists/yr in 10 years time)
20% mass	Increases in any type of tourists is encouraged and expanded
Construction alternatives	Definition of construction alternatives*
No construction	No construction is permitted which has negative impacts on the marine environment
Harbour extension	Construction of a harbour extension is permitted and occurs
Cattle Plantation resort	The Cattle Plantation resort including marina and golf course is permitted and occurs

* An approved Environmental Impact Assessment is assumed

The hierarchy is prioritized at the top level according to the Executive Council (on average) and further prioritized as per the chair of the SCF and manager of the SMP. The alternatives are weighed relative to each other by the author. A time lapse of 10 years is assumed.

Results

Indications are that increases in tourism will, after 10 years, have negative impacts on the overall goal of the Saba Marine Park. Part of the impacts are likely to be positive (e.g. economic benefits accruing to the community) but these would be outweighed by negative social and ecological consequences for SMP objectives (Table 7).

In ecological terms no construction is, predictably, preferred to any construction. However, results indicate that a harbour extension may be more desirable overall when considering social and economic objectives associated with SMP.

Table 7. Relative degree to which different decisions lead to achievement of community identified objectives of SMP over a period of ten years.

Objective	Tourism level*			
	Current	10%	20%	20% mass
Overall goal	.379	.364	.143	.114
Ecological	.636	.225	.071	.069
Economic	.072	.510	.237	.182
Social	.429	.362	.116	.093
Global learning	.607	.258	.084	.051
Objective	Type of construction *			
	None	Harbour	Resort	
Overall goal	.445	.461	.094	
Ecological	.760	.183	.057	
Economic	.143	.714	.143	
Social	.408	.512	.081	
Global	.691	.249	.060	

* Definition of these decision alternatives in Table 6 above.

Discussion

If considering community desires for the future of Saba's marine environment, the results indicate that lesser scale tourism and associated development may be more valuable than larger scale development. It may even be possible that no significant increases in the number of visitors may lead to higher achievement of the community derived objectives for SMP.

These results are illustrative and would require further input from the decision makers involved and more relevant data collection to reflect the Saban situation better.

APPENDIX J. Baseline status of Saba Marine Park, August 1994: Using the SMP objectives hierarchy as a monitoring tool.

Introduction

The successful progress of any management decisions or actions can only be assessed on the basis of a monitoring program. If a management agency has multiple objectives then the degree of progress within each objective should be monitored. Overall progress can be indicated by summarizing or integrating the measures of movement towards or from each objective. I present a method by which the progress of Saba Marine Park towards the multiple community defined objectives can be measured over time.

Methods

The value tree generated based on community defined objectives of SMP can also be used for measuring the progress of the Park towards its objectives. The difference in the models used is at the lowest level. The alternative time periods replace the management alternatives as the lowest level of the hierarchy to be compared. Positive progress towards all the objectives overall will be indicated when later years have greater "value" than earlier years.
The monitoring indices used here are the attributes identified in Table 2 (and Appendix D). The levels of each attribute as at August 1994 are also given in Appendix D. The Analytic Hierarchy Process allows the monitoring indices to be quantitative or qualitative. In either case they are scaled from 0 as minimum (or undesirable) level of achievement and 1.0 as the maximum (desirable) level of achievement. These indices, rather than preferences, provides the basis for comparison for future improvements or declines in achievement of objectives. As more quantitative measures become available they can be introduced by scaling measurements onto the qualitative yardsticks being used.

Results

The monitoring tool will begin to provide results as soon as the next assessment of the state of the attributes is conducted. This could occur, usefully, after a period of a year. Due to the time scale of the analysis, the monitoring tool is less likely to detect gradual changes over shorter periods of time. The objectives hierarchy used as a monitoring tool is illustrated in Figure 7.

Discussion

This monitoring tool can also detect changes in the major sub-objectives separately. For example, the amount of progress towards the objective of social acceptability of SMP can be considered separately. This possibility minimizes the chance that significant progress within one group of objectives will obscure major declines in achievement of other objectives.
This tool is, however, limited by the quality of the data available to input. If the chosen quantitative environmental measures are not sensitive to detecting undesirable changes then this monitoring tool will reflect that inability also.

Figure 7. Community derived objectives hierarchy for Saba Marine Park as a monitoring tool. Prioritization derived here are according to the preferences of the chair of the Saba Conservation Foundation (SCF). Numbers in parentheses under objectives represent weightings given to each objective which reflect the chairperson's opinion as to their relative importance to achieving the higher level objectives (as in Fig.5, Appendix E). At the lowest level are different years in which the monitoring can be conducted and compared. Next to 1994 are attribute levels of objectives as at August 1994. They are taken from Appendix D and normalized on a scale from 0 (minimum or least desirable value) to 1.0 (maximum or most desirable value). Legend is as in Figure 2.