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1.0 INTRODUCTION

The monitoring and enforcement plan provided herein describes the conceptual framework for monitoring, identifies basic elements of the monitoring program, characterizes the information database, and provides a general action plan for enforcement. Goals and objectives of monitoring and enforcement are derived from numerous consultations with stakeholders, workshops on key elements of the PAMP and related documents, available information on regional resources and human populations, and on data collected during natural and human resource inventories conducted as part of PAMP development. Descriptions and rationale provided in this plan are intended to be used as the basis for developing annual and long term monitoring and enforcement programs.

The vision statement for the Protected Area includes the major ecological and human values to be protected. As these are the elements identified as values to be managed and preserved, the monitoring program is designed to collect data relevant to their sustainable management. These key elements are:

- Healthy Natural Ecosystems (forest, mangrove, and marine);
- Functional components of these ecosystems; and
- Human use values.
- Specific ecological and human use values identified by stakeholders during the process of plan development include:
    - Habitat (food and shelter) for native flora and fauna,
    - Regeneration and reproduction of native flora and fauna,
    - Clean water,
    - Flood control,
    - Fisheries,
    - Successful tourism,
    - Model management for application elsewhere,
    - High quality human environment,
    - Cultural traditions of indigenous people,
    - Food, medicine, housing, recreation, and education, and
    - Landscape vistas for development purposes.

Development of a detailed monitoring and enforcement plan must provide specifics regarding those elements to be measured, their location, and frequency of measurement. The format should follow the framework presented in section 6.2 in order to proceed in an orderly and well-documented manner. Guidance and suggestions are provided in this plan, but detailed plan development will require an additional level of effort, balanced with available resources and funding. The final plan will have to consider factors that

have not been determined at this point, such as institutional arrangements with other government units and agencies, and cooperative agreements with NGOs or research institutions.

Sustainability of protected area values for current and future generations is a basic tenet of the PAMP, which recognizes that these values are sustained by having:

- Environmentally aware citizens and visitors,
- Integration of surrounding communities and other stakeholders in management planning,
- Adequate regulatory safeguards, and
- Representative PAMB.

The PAMP considers these elements and recognizes that information must be collected periodically to help guide long term management of the protected area in order to sustain its values. Monitoring, therefore, involves the collection of data pertinent to each of the identified values. Data collection can involve a variety of measurements directed at assessing the health and sustainability of ecological values (e.g., reproductive success in birds, benthic biodiversity, primary productivity) or for measuring parameters used as criteria found to be generally indicative of environmental health (e.g., water quality criteria). Comprehensive monitoring also includes measures of human use of the protected area so that impacts can be identified, measured, and mitigated as part of the overall sustainable management. The monitoring program should, therefore, be based on a framework that is decision-focused and systematically monitors key indicators of protection and sustainability of the vision elements and protected area values in an efficient and cost-effective manner.

2.0 MONITORING FRAMEWORK

2.1 Decision Based Structure

Effective monitoring collects data to help make management decisions regarding the condition of the protected area. The Data Quality Objectives (DQO) approach (USEPA 1993) is decision-focused process for collecting data. The approach has been adapted for monitoring and provides a systematic, comprehensive, and flexible framework for monitoring the complex ecosystems of Subic Bay. The process consists of seven steps; adapted for monitoring program design (Reagan 2000), these are:

- State the management objectives,
- Identify the management decisions to be made,
- Identify inputs to these decisions,
- Define the study boundaries,
- Develop decision rules,
- Specify limits on decision errors, and
- Optimize the design for obtaining data.

2.1.1 Management Objectives

For monitoring purposes, the management objectives are derived from the goals, mission, and vision statement for the PAMP (Volume 2, Section 2). These can be stated in terms of the exceedance of pre-determined criteria or tolerance limits of measured parameters directly related to the stated values to be protected, trends over time, or unforeseen/unexplained changes in the parameters being measured.

2.1.2 Decisions to be Made

There are three basic types of decisions to be made for each element of the management plan:

- Conditions are satisfactory, and routine monitoring data collection should continue.
- Conditions are unsatisfactory or are headed in an unsatisfactory (i.e., unsustainable) direction.
- Conditions have changed, but additional data are needed in order to make management decisions.

All such decisions should be identified early in the development of a monitoring program.

2.1.3 Inputs to Decisions

Inputs to the decisions should come primarily from data collected as part of the monitoring program, from existing information on baseline conditions, and from directed studies to fill identified data gaps. Information can come from existing records maintained by agencies (e.g., Department of Tourism) or be collected directly in the field. Information needs to support decisions are identified in the initial program. These need to reviewed periodically in order to determine what, if any, additional environmental measurements are required. Potential sampling approaches to measure effects and/or stressor levels and stressor thresholds (e.g., exceedance of water quality criteria, reduction in tree cover within the protected area) should be described in adequate detail.

2.1.4 Study Boundary

Boundary definition includes the spatial and temporal aspects of the environmental media involved. The geographic areas of interest, characteristics that define affected populations, scale of decision-making, and time frame to which the decision applies should be specified. Monitoring boundaries should generally be restricted to the management zones of the protected area and buffer zones as identified in the PAMP. SBPA boundaries and management zones and buffer areas are shown on Figure 1.

2.1.5 Decision Rules

The development of decision rules is critical to monitoring program development. Logical "if…then" statements define the conditions that allow the risk manager to choose among alternative actions (e.g., to continue monitoring, take corrective action, etc.). Decision rules can be simple or complex, depending on the ability to quantify parameters and define unacceptable conditions.

Decision rules for parameters such as water quality can be made on the basis of exceedances of thresholds or criteria that have been developed as indicators of healthy conditions. These criteria can be obtained from existing agencies or programs.

Decisions for factors such as sedimentation rates, percent vegetation cover are more arbitrary. There may not be an identifiable threshold value that indicates unhealthy conditions, but persistent trends of increased sedimentation or declining canopy cover may be indicative of declining health and trigger additional investigations regarding the cause and potential remedies for such changes.

2.1.6 Limits on Decision Errors

Specifying the limits of decision errors is an important step that will be used in the last step, optimizing the design of the monitoring program. The purpose of this step is to design a monitoring program that limits the chances of making decision errors to an acceptable level. Both *sampling errors* and *measurement errors* are combined into a *total study error* that is directly related to decision error.

Figure 1 Subic Bay Protected Area Boundary and Management Zones

2.1.7 Monitoring Study Design

In the final step, the monitoring study design is optimized based on a review of the DQO process outputs. The purpose is to identify the most resource-effective sampling design that generates data that satisfies the specified DQOs. Following these steps ensures that the resulting monitoring program will collect all (and only) data necessary to make the various decisions specified in the monitoring program. Knowing in advance what decisions are to be made, what data are necessary to make the decisions, and how the outcomes of data analysis will be used to make decisions is beneficial to all stakeholders. The substantial savings of effort and costs over the life of the program more than justify the application of the DQO process for monitoring purposes.

2.2 Assessment Endpoints for Monitoring

The monitoring program should establish clear objectives derived from the overall PAMP goals (see Vol. 2, Section 2), which are based on the stated values to be protected, identified during inventory surveys, and augmented by inputs from stakeholders during public consultations and workshops. These are generally referred to as Assessment Endpoints (AEs).

AEs are the explicit environmental values to be protected, operationally defined as ecological entities and their attributes (U.S. Environmental Protection Agency 1998). In assessment and monitoring terms, three criteria are used for selecting AEs:

- Ecological relevance,
- Relevance to management goals (societal relevance), and
- Susceptibility to known or potential stressors.

Ecologically relevant endpoints are those that reflect important ecological characteristics and are functionally related to other endpoints. Endpoints based on ecological values that people care about have social, economic, and management relevance. The ecologically relevant values and human values derived from the ecosystem comprise the general assessment endpoints (GAEs) of the PA. GAEs for ecosystems within the PA provide a comprehensive summary of the ecological and societal values for the PA.

These values provide a basis first for selecting site-specific AEs for monitoring. These values will vary with the category of protection. For example, measures of overall biodiversity would be appropriate in the core zone as well as sustainable use zones, but measures of economically important species such as rattan or buho would be most appropriate in zones where harvesting is a permitted use (e.g., sustainable use zone).

Measurements are taken to provide information relevant to the health and sustainability of a particular AE or group of AEs. These measurements provide information on the status or trends in the condition of ecological values. Measurements should be selected to address the following considerations:

- Which environmental parameters are relevant to the broadest range of PA values?
- Are measurements of physical factors sufficient, or are direct measures of effects on flora and fauna necessary for management decision-making?

The ultimate value to be protected within the protected area is a healthy sustainable ecosystem. Protection of other values, such as populations of endemic plant and animal species, are consequences of habitat protection and the maintenance of healthy ecosystems. The conceptual approach for PA management is a scientifically based process termed ecosystem management (Christiansen 1996). As such, monitoring data are required to make management decisions.

Values that can be measured to indicate the health of the natural ecosystems include measures of biodiversity, patterns of organization, and nutrient and energy dynamics (e.g., productivity). Burley and Gauld (1995) list several categories of potential biodiversity indicators:

Species-area relationships - used to describe/measure species richness within an area
Keystone species - species that play a major role in maintaining ecosystem structure and integrity (e.g., giant fruit bats, figs)
Ecological indicator species - Species that are indicative of changes in environmental conditions affecting a large number of species
Economic valuation species - species that have economic value (e.g., rattan palms, bamboo).

These measures may have general applicability, or may be more important in certain subzones of the protected area. For example, fruit bat populations are important keystone species whose populations can be assessed in the habitat management zone, whereas populations and production of economically important species would be appropriate indicators in sustainable use zones.

2.3 Special Monitoring Considerations

Once the ecological and human use values have been established, other considerations may be important for establishing monitoring goals. Although it may appear obvious, the type of ecosystem(s) affected by anthropogenic disturbances that will be allowed to remediate naturally must be considered. The composition of these communities will dictate what species or aspects of ecological organization will be selected for monitoring.

In general, it will be appropriate to select at least one measure for each of the affected assessment endpoints identified.

In some instances monitoring may focus on indicators (McKenzie *et al.* 1992). These may be selected because of their societal value (e.g., charismatic megafauna) or because the indicator species has been identified as the most sensitive species to the adverse effects of stressors in the ecosystem (e.g., extraction of harvestable resources such as buho or rattan). In the latter instance, it is assumed that if the effects or harvesting are maintained below acceptable levels, risks to the ecosystem are also within acceptable levels.

Other important considerations in designing a monitoring program are the types of natural or human-induced stressors involved, the location and type of strss, and affected resources. For example, it is possible to monitor populations of indicator species (e.g., giant fruit bat, bamboo bat, blackspot damsel, selected corals and seagrasses) or the factors that may lead to declines in their populations, such as sedimentation, turbidity, or water quality.

2.4 Directed Studies

There is also a need for well-designed studies to advance the understanding of natural relationships and processes in the protected areas. The point is that, although monitoring provides an important component of ecosystem management, it alone does not have adequate power to address current or future problems. Directed studies can have either applied or academic objectives. However, they need to be focused on the ecosystems and environments that control conditions within the protected area.

The point of directed studies, as opposed to data collection for monitoring purposes, is to improve management of the protected areas. For example, at this time we have only a rudimentary understanding of the complex current patterns in the bay and how they change with different tides, winds and river inputs. A directed study could classify the different types of circulation patterns and identify those that are associated with seasons or times when pollutant loads are least diluted. This study might also identify the most direct flow paths between the major pollutant sources and critical areas such as swimming beaches, reefs or aquatic entertainment facilities. These results then could be used to identify whether critical levels of pollution or eutrophication will occur and to better design monitoring data collection to address this potential problem.

Data collection during the PAMP project inventories was aimed at characterizing natural resources as the basis for establishing protected areas, determining boundaries around the protection area, and defining categories of protection within the protected area and surrounding buffer zones. However, quantitative data of a sufficient quantity and quality

to serve as baseline was not the focus of these surveys. Such information remains to be collected as the basis for monitoring. Data on current patterns in the bay, baseline data on the functional groups occurring in major streams of the protected area, and quantitative data on important animal populations (e.g., fruit bats) should be monitoring priorities. Many such directed studies are needed as the basis for monitoring.

Such directed studies can be encouraged by a number of mechanisms. A field station is proposed as part of the PAMP and the facilities and logistical support of this facility can attract researchers who are responsible for generating their own financial support. Furthermore, if there is an organized program of studies and a field station facility, it is possible to attract funding from worldwide agencies and foundations. In this system, proposed individual studies can be organized and grouped into an overall program. Funding can be pursued individually by each potential participant or for the whole program.

3.0 MONITORING PROGRAM

The following monitoring program description follows the general DQO framework presented in section 6.2; however, the final decisions regarding specific decision criteria and monitoring design are features that cannot be considered prior to decisions regarding PA management structure and budget have been determined.

Much of the monitoring program described below could be done efficiently from a research facility within the SBPA. Subic Bay is an ideal location for an environmental research station, mainly because the area harbors one of the largest remaining areas of natural forest in Luzon. However, a Subic Bay research station could have both terrestrial and marine programs. Such a research station would greatly facilitate the environmental monitoring needed for the SBWR. Going beyond monitoring itself, a research station would help promote basic and applied research into ecological processes that is needed to understanding trends revealed by monitoring and to devise management tools for conserving the area. As examples, we need to know more about the ecology of the fruit bats in order to protect them, and we need to know more about local forest ecology to develop effective forest restoration.

3.1 Marine Environment

Marine ecosystems within the SBPA are contiguous with the Subic Bay ecosystem and adjacent to the marine environment of the South China Sea. In consideration of this situation, monitoring for sustainable management of these ecosystems must consider the entire bay and its catchments.

Management Objectives
General management for the SBPA are provided in Volume 2, Section 4. Consistent with the ecological and human use values identified by stakeholders during public consultation workshops, specific management objectives for the marine protected area may include the following:

- Protection and management of marine areas significant to the life cycles of economically, aesthetically and ecologically important marine species (e.g., coral reefs, seagrass beds, beaches)
- Protection of remaining mangrove forests in order to maintain their buffering functions between the land and sea ecosystems, protection of landward ecosystems against typhoons and wave action, and protection of the reefs from sedimentation
- Management of fisheries resources within the bay such that the bay may be able to provide, on a sustainable basis, livelihood to local fishers and at the same time contribute aesthetically to the tourism (particularly to the diving) industry

- Preservation and protection of cultural sites and their aesthetic value as a legacy to future generations
- Physical delineation of selected areas identified for various levels of protection
- Facilitation and coordination between identified stakeholder groups such that all concerns and interests are acknowledged and considered throughout the implementation of the management plan

Study Boundary

For purposes of fund conservation, biophysical monitoring may be limited to the proclaimed area at the onset. However, the buffer zones and other marine ecosystems external to the proclaimed areas to include the IEC zone in the innermost portion of the bay should eventually be included in the comprehensive PA monitoring program. The boundaries for studies needed to evaluate the health and sustainability of marine resources, therefore, include the management zones of the marine portion of the protected area, buffer zones, and catchment areas of the upper bay.

Decisions To Be Made

Since the zoning approach has been recommended for the bay, certain decisions regarding spatial and temporal allocations have to be decided in order to minimize the levels of deprivation of certain stakeholders. Such decisions include:

- The exact duration of fishing moratoriums.
- The mode of relieving the fishing moratoriums after an agreed duration of implementation. Some species may be able to recover faster than others as may be deduced from the monitoring data. It may not be possible to allow the lifting of moratoriums for all species at the same time. In the same context, some areas may be able to recover faster or slower than others and may require the lifting or lengthening of moratoriums. It is thus necessary to establish decision criteria towards the lifting or prolonging fishing moratoriums.
- Which stakeholder group should act as watchdog or guardian for what geographical scope / area / etc. Although SBMA is charged with the overall implementation of the management plan, real implementation will only occur if stakeholder groups actively participate in monitoring and enforcement of the guidelines they have agreed to as provided by the management plan.
- In relation to 'watchdog' groups, the decision on what types of training are to be recommended for the area. Monitoring groups need to be empowered with knowledge, monitoring skills and preliminary evaluation skills.
- Although the SBMA is tasked to implement monitoring, they have to acquire expert assistance in bio-physical monitoring of the area in terms of fish census and coral recruitment monitoring.

- Although a zoning plan has been presented, changes in use levels, future recovery or degradation of the marine area or other unforeseen occurrences will dictate the expansion or decrease in area allocation of each of these zones.

Inputs to Decisions
The first concern bio-physical parameters, as follows:
- Trends in water quality
- Periodic fish census information
- Periodic coral health and recruitment information
- Status of seaweed and seagrass populations
- Sightings of turtles and their nesting sites

The second concern broad social parameters, as follows:
- Job differentiation of stakeholders as a result of fishing moratoriums (fishers, resort owners, etc.)
- Changes in the income structure of the most affected stakeholders
- State of environmental awareness of both local and non-local tourists
- Trends in tourist populations, composition, seasonality, preferences, spending allocation, etc.

The third concern land use and indigenous peoples parameters, as follows:
- Levels of use of the mangrove areas, to include conversion (to golf courses, fish ponds, etc.) and / or replanting patterns, use levels of traditional communities, etc.

Finally, there are staff and training parameters, as follows:
- Training needs assessment
- Results of job and task analyses

Decision Rules (examples)
1. If fish populations have not reached a level that may be sustainably fished in the area, the fishing moratorium should be maintained.
2. If more endangered species are recorded in monitoring activities, their habitats have to be protected in addition to the zones identified in the plan.

Actual plan design involves translating the objectives, boundaries, inputs, and decision rules into a comprehensive monitoring program.

3.2 Physical Parameters

Monitoring design for physical parameters in the marine environment follow standard approaches adapted for the specific conditions in and adjacent to the bay.

For this reason and because this scale of monitoring transcends the specific zones, details of sampling approach can provided here that are not appropriate for other parameters in other media.

Catchments and Marine Environments

The marine environment requires monitoring to determine if pollutant and nutrient loads are exceeding the capacity of the natural system to disperse and assimilate them. The assimilative capacity of the natural systems is different for each load and it varies in time over scale ranging from hours to decades. It is therefore necessary to understand the processes within the receiving environments (i.e. the coves and the bay) and the impacted ecosystems (e.g. the grass beds or the reefs) that respond to these loads and the capacity of these systems to cope with appropriate levels of the loads without harm. A key element in developing this understanding is the development of an adequate long-term database of environmental and biological parameters.

A properly designed long-term database can be used both for simple and direct monitoring of ecological health parameters and as a powerful tool to develop an understanding of cause and effect relationships between stimuli (e.g. time varying nutrient loads) and response (e.g. outbreaks of potential harmful plankton blooms). The basis for a long-term marine monitoring program already exists. In the course of the resource inventory studies that are part of the protected areas management plan project a digital database was created. Maps and data were stored for later retrieval and use. This database is described in section 4.

In setting up the resource inventory studies the marine environmental data from previous studies was identified. These previous studies were based on one, or at best a few, sample set and these have not been distributed on a systematic schedule (i.e. monthly, seasonal, etc.). There is clearly a need to go forward by establishing such a systematic program of measurements and data archiving.

The schedule for monitoring should be regular but not necessarily exact. Although there are two distinct seasons it is necessary to monitor at more than a seasonal interval so that different conditions of temperature, rainfall, river discharge, etc. are eventually encountered. The optimal schedule would be once every two months.

Meteorology

Virtually all aspects of the environment are forced by, or respond to, weather. Monitoring is carried out at the airport and its location is well suited for most applications of the resulting data. This program should be considered. Minimum data requirements are: a) hourly average 10-m wind speed and direction, b) daily rainfall (hourly average, or

continuous would be better), c) hourly average or continuous solar insolation, d) temperature (hourly), e) barometric pressure (hourly), and f) percent cloud cover (hourly).

River Flow

The resource inventory study demonstrated the importance of stream flow data. It found existing data to be sparse. The freshwater input and the environmental loads to the marine system (nutrients and pollutants) are determined from stream flow data.

There are eleven rivers and significant streams flowing into the bay and the coves of the adjacent coastal waters. The best plan would be to provide an automated and telemetering gaging station on each of these streams. This would provide real-time monitoring so that instances of data losses due to instrument failure or vandalism can be quickly detected. However, the scheme used in the hydrology inventory report could be followed to reduce costs, from eleven to five gaging stations. One gage could be located on a river in each group and rainfall/runoff relationships could be developed for the rest. This grouping was (the principal river in each group is highlighted):

- Group 1
  Marelalec River
  Nibangon (Calapandayan) River
  Matain River
- Group 2
  Santa Rita River
- Group 3
  Binictican/Malawaan River
  Boton River
  Minanga River
- Group 4
  Cawag River
  Agusuhin (Quinabuscan) River
- Group 5
  Wild Horse River
  Deer Creek

Hourly data should be collected at these stations because the drainages are short and steep. Both hourly and daily average flow and stage data should be archived in the database.

Combined Physical Monitoring

A program of combined marine monitoring should be implemented to collect a variety of data at common stations distributed over the bay and adjacent coastal waters. The 23

stations used in the resource inventory studies could provide a reasonable set of locations to be continued. As noted above, sampling once every two months is adequate. The following parameters and sampling intervals should be regarded as a minimal program:

Physical Parameters
Physical parameters should be collected 0.1 m below the surface and 0.1 m above the bottom at each station. In addition, these parameters should be measured at 1-m intervals where the water depth is less than 10 m; at 2-m intervals between 12 and 30 m and at 3-m intervals at greater depths. Based on the experience gained during the resource inventory studies, profiles based on this sampling scheme will resolve the main features of stratification in the bay when it is present.

The parameters that need to be measured include temperature, conductivity, and salinity. These are best measured with an over-the-side probe which could be a CTD unit or a water quality sonde such as those available from HydroLab or YSI. In these cases the instrument depth is read and should be included in the data. Secchi disk profiles should be taken at each station to record water clarity.

Water Quality (Probe) Parameters
Most water quality sondes are lowered over the side of a boat and measure a standard set of parameters at different depths. These are called "Probe" parameters. In addition to salinity, temperature and depth these usually include dissolved oxygen (DO), pH, conductivity, and ORP. Newer models include measurements of turbidity and chlorophyll. These measurements should be made at the depth-intervals given for the physical parameters.

Laboratory Parameters
Nutrient, municipal waste and pollution parameters need to be measured from discrete samples that are returned to a laboratory for chemical analyses. These tend to be relatively expensive measurements so they are applied sparingly. Also, several parameters are subject to holding time limitations that means there is a motivation to establish appropriate analytical capabilities at a laboratory in the Subic Bay area, perhaps as part of the field station.

Sampling should be conducted at the marine stations discussed above and at a station in each of the rivers that contribute significant loads to the bay. The river stations need to be located close to the river mouth so that all of the sources contributing to the pollution load are upstream. However, the river station should be located sufficiently upstream of the mouth that reversing tidal flows cannot contaminate the sample with water from the bay. Water samples from these stations should be composited over the depth if the river is more than 2 m deep and taken at mid-depth where the water is shallower. The marine

samples should be taken at 1-m below the surface and 1-m above the bottom at all stations.

The parameters that should be determined every two months include: Ammonia, NO2, NO3, Total Nitrogen, Total Organic Nitrogen, Total Particulate Nitrogen, Total Phosphorus, Ortho-Phosphorus, Total Organic Carbon, Particulate Organic Carbon, Dissolved Organic Carbon, Total Carbon, Particulate Carbon and Silica. Fecal coliform (or another similar or superior parameter) should also be monitored.

The resource inventory surveys showed that pollution from metals in the water is not presently an issue. However, given increasing port activities, metals should be measured at least annually. These include: AS, Cd, Cu, Pb, Zn, and Hg.

Beach Monitoring

Monitoring of beaches within the overall protected area can be done easily by systematically studying aerial photographs that may become available on an opportunistic basis or by special over flights. A limited number of beach profile monitoring transects should be set up and marked with permanent survey monuments. These beach profiles can be measured annually. By combining the data from the photo-analyses and the beach profile measurements it will be possible to systematically measure the progressive changes on the shoreline. The resource inventory report showed how the sandy ash from the Mt. Pinatubo eruption provided an excess of beach sand resulting in the out-building of beaches in the early and mid-1990s. In many cases these beaches are now eroding back to their more natural states. It will be important to systematically identify and track these changes so that development near the shoreline can be properly planned without resorting to expensive, and potentially environmentally threatening, shore-defense structures.

Data Analyses and Modeling

It does little good to collect monitoring data without an organized plan to analyze these data. The major objectives of the analyses are to: a) continue to update the assessments of the ecological balance and environmental conditions of the protected systems, b) to characterize the variability of the data (to separate meaningful trends from natural variations in conditions), and c) to be able to make reasonable predictions and assessments of future conditions. Predictions of future conditions are especially valuable when evaluating the potential impacts of proposed new facilities and in assessing the expected duration of periods of recovery for damaged system components.

The systems that are within the protected areas are too numerous and varied to dictate a unified system of data analyses. Instead, managers should take advantage of the large base of talented scientists and engineers in the Philippines. An organized procedure to receive and evaluate proposals from qualified institutions and individuals can be used to

great effect to see that monitoring data are taken according to approved protocols and analyzed in meaningful ways.

One area of data analyses is particularly useful in using monitoring data to make management decisions and to continually refine environmental policy. This is the area of mathematical modeling. When properly applied, relatively complex physical, biochemical and ecological processes are represented in quantitative frameworks. This serves to greatly reduce subjective evaluation of complex data sets. It also provides a tool that allows expanding understandings derived from the measured data extended to conditions, or durations, that have not occurred during the periods of measurement. For example, chronic pollution loading effects within the bay can become acute during extended periods of low-river input. This is often characterized by relating to measurements made elsewhere during standard low-flow conditions (often taken as conditions with a 10-year recurrence interval). It can be very difficult and expensive to wait until appropriate 10-year low-flow conditions occur to make measurement. It is relatively expedient to predict such conditions with a numerical model (e.g. say of the hydrodynamics and water quality processes in the bay). However, whenever numerical modeling is considered or proposed, it is necessary to engage experienced reviewers to be assured that proper mathematical models, supporting data sets, and modeling methods are applied.

3.3 Biological Parameters

During the resource inventory study the plankton, dinoflagellates , and benthos were sampled at all of the water quality stations. The analyses showed that the plankton and benthos communities are composed of a normal balanced group of species. However, cysts of certain species of potentially harmful algae were found in the bottom sediments at several locations. Given the relatively high, and growing nutrient loading of the bay and the port activities that include ballast water discharges that can introduce seed populations of undesirable dinoflagellates and plankton, it is prudent to continue twice-yearly monitoring of the plankton. This need not include exhaustive classifications of all organisms in the samples. The examinations should be directed only at screening for the occurrence of red tide organisms or other harmful algae bloom species.

Other parameters that have been identified as inputs into decisions regarding the management of marine zones and buffer zones include the following:

Periodic fish census information

Periodic data on the populations would provide information critical for the management of this resource in the SBPA and adjacent areas of Subic Bay. One of the important findings of resource inventories was that fish production in the bay was higher than expected, and that this could be attributed to the large areas of the bay protected from

fishing. This protected area provided nursery areas for many species consumed by communities around the bay. Continued sustainable management of this resource will require periodic direct information on fish populations in order to make management decisions.

Periodic coral health and recruitment information

Data on coral health and recruitment are vital to understanding and managing these habitats in the SBPA. Data on reef location and condition collected during inventory surveys can be used as a baseline for monitoring trends in cover, diversity, and general condition of reef areas within the SBPA and adjacent buffer zones. Important sources of coral recruitment identified during inventories should also be monitored periodically. Surveys at regular yearly intervals should be sufficient, unless rapid changes in reef condition are detected.

Status of seaweed and seagrass populations

Cover, diversity, and extent of seaweed and seagrass beds were recorded during inventory surveys. This information provides a baseline against which changes in these parameters can be measured. Such trend data can be used to make management decisions as described in Section 6.2.

Fortuitous data on important species

Continuous records should be recorded of sightings of sea turtles and their nesting sites, or other important but rarely seen species (e.g., marine mammals). Over time such data can be used to identify critical habitat in need of protection or in the design of protective measures within designated management zones. In some instances it may be appropriate to modify management zones to relax or impose restrictions, as data indicate.

Secondary items to be monitored in relation to marine ecosystems include the following social parameters:

- Job differentiation of stakeholders as a result of fishing moratoriums (fishers, resort owners, etc.)
- Changes in the income structure of the most affected stakeholders
- State of environmental awareness of both local and non-local tourists
- Trends in tourist populations, composition, seasonality, preferences, spending allocation, etc.

These parameters are not part of marine monitoring, but are addressed under social indicators in Section 6.3.3. In particular, land use and indigenous peoples parameters such as levels of use of the mangrove areas, including conversion (to golf courses, fish ponds, etc.) and / or replanting patterns, use levels of traditional communities, etc. The awarding of Ancestral Lands title to the Aeta of Pastolon and participation of the Aeta on the PAMB is expected to resolve these potential issues.

Finally, there are staff and training parameters, including training needs assessment and the results of job and task analyses. These have been addressed in Section 4.

3.4 Terrestrial Environment

General management objectives for the SBPA are provided in Volume 2, Section 5. The ultimate value to be protected is a healthy sustainable ecosystem. This includes biological diversity, productivity, and other ecosystem parameters. Biological diversity of the environment must be periodically assessed to ensure that it is not deteriorating. Various measures of biodiversity were mentioned in Section 6.2.2. Simple direct measures, such as species richness (total number of species in an area) can also provide useful information on the composition of the plant or animal communities. Such lists are also useful in evaluating the functional group composition of an area. Environmental monitoring is especially needed to detect impacts and evaluate the effectiveness of management and to either collect more data or take remedial action.

There is usually much short-term variation in environments due to natural and human causes. These do not necessarily indicate trends. Therefore to distinguish short- from long-term change environmental monitoring must repeatedly measure the same features over long periods.

Of course, it is not possible to monitor all aspects of an environment. Time and funds for monitoring are limited. Many features of an environment are difficult to survey, and not all features are equally important. Therefore, a monitoring program must focus on a few features that are important and easily surveyed.

This section provides a conceptual description of a monitoring program for the terrestrial environment of the Subic Bay Protected Area, including climate, spatial changes in vegetation, forest composition and structure, and fruit bat populations. Ideally, monitoring should be part of a larger research program based at an environmental research station to be established at Subic Bay.

3.4.1 Physical Parameters

Although physical parameters play a critical role in the health and sustainability of the forest ecosystem, they are less critical parameters for marine ecosystems. Standard weather data, as described in section 6.3.1 should be sufficient for both marine and terrestrial purposes. Air data are not pertinent in the foreseeable future, because air quality was found to be good, and there are presently no developments planned that would suggest rapid deterioration.

Climate and soil are the main determinants of vegetation type, and vegetation type is an indication of plant and animal species composition and diversity. Whereas the main features of soil are relatively stable in the time scale of interest, climate does change and today, due to possible global warming, may be changing especially fast. Therefore, climatic monitoring data should be acquired and added to the database (see section 6.4). The important parameters to measure are: temperature, rainfall, and solar radiation. These should be measured every day. Also, records of the frequency and intensity of cyclonic storms should be kept. Presumably, climate is already being monitored by SBMA, but methods and parameters should be assessed to ensure that they are at suitable locations and of adequate frequency for environmental monitoring purposes.

3.4.2 Vegetation

Spatial changes in vegetation

The most essential and obvious measure of conservation in Subic Bay is the spatial extent of forest and other vegetation types. At a minimum, the basic structure and extent of the mature forest vegetation must be conserved. In designated areas, second growth trees should be permitted to mature, and grassland/shrubland areas that were formerly forest should be restored. These efforts at protection and forest expansion can be evaluated by analyzing aerial photographs or satellite imagery. Mapping the changes in vegetation cover within the various management zones will provide a basis for evaluating condition, extent, and restoration over time. It is recommended that these photographs or images be obtained and analyzed at least every five years. If rapid changes are detected, more frequent monitoring should be considered.

Forest composition and structure

Forest dynamics are the changes in composition and structure of a forest through time. Composition refers to the complement of tree species in the forest. Structure refers to three attributes of a forest: 1) physical, that is, three-dimensional structure; 2) size-class structure, normally the numbers of trees in different diameter classes in a forest; 3) community structure, or the total number of tree species in the forest and their relative abundances. To monitor forest dynamics in the SBPA, at least part of the Terrestrial Flora Resources Survey carried out for the PAMP be repeated every five years. These re-surveys will provide long-term record of changes in forest composition and structure originating from a substantial, well-planned inventory. These data can be used to discern trends in the composition, structure, and diversity of the plant community over areas of interest. The inventory survey data have all been analyzed and geo-referenced in the database (section 6.4), making future comparisons easy.

3.4.3 Fauna

There are good methods for birds and reptiles census in tropical forests. However, observations of these can vary greatly from one day to the next, depending on season, weather, time of day, and chance. For example, a subset of the bird community can be reliably evaluated annually using mist-nets. Walking surveys and other methods can be used to record species occurrence and general abundance within different zones to provide a baseline data set, then periodically repeated to discern trends or detect radical changes. Thus these groups must be evaluated fairly often, which may be impractical, unless a research program and frequent presence of researchers is established at Subic Bay.

The giant fruit bats in the SBPA help conserve the biological diversity of the ecosystem, since they are probably essential for the dispersal of seeds and maintenance of plant diversity. In turn, since the bats probably depend for their food on healthy populations of a variety of plant species, the status of the bats can be an index of the status of the ecosystem. These bats are also a valuable tourist attraction. They are also easy to monitor, since they are large and roost by day in fairly clear view. Therefore a census of the fruit bat population be conducted about twice a year.

The existing fruit bat population project at Subic Bay is a good starting point for long-term monitoring of this species. The roost is located in a habitat protection zone, thus the species and location are known. Monitoring should consist of measurements that take note of the presence, general abundance, and habitat condition. Habitat condition can include the presence of structural habitat (e.g., trees), but also the state of protection (e.g., are enforcement controls sufficient to prevent disturbance or are people entering the roosting area and disturbing the bats). Checking on the roost should occur at frequent intervals and can be accomplished as part of routine ranger patrols that include this area.

3.5 Socio-Economic Indicators

This section is concerned with the gathering and monitoring of socio-economic statistics that are directly relevant to the management of the PA and the operation of the PAMP. To begin with, this involves the PAMB retaining broad information on growth/development in the SBFZ and wider national economy, as well as overall adjustments within the commercial business sector.

There are several vital aspects to the need for regional socio-economic statistics. The first is to have knowledge of the population that the PA serves. This can be regarded as the 'constituency' of the PA – the population that will support the ongoing existence of the PA because they value it for a variety of reasons. It includes nearby residents and businesses, and the broader tourism and recreational visitor population of Manila and

Luzon. The data collection and monitoring should be designed to determine the overall demographics of population and businesses versus the proportion directly or potentially concerned with the PA.

Other important data concerns the measurement of visitors to the PA, and prediction of future visitors. There is also a need to distinguish between different visitor types, for example:

- visitors to the forest or marine environment (walkers, trekkers, wildlife enthusiasts, scuba divers, etc);
- visitors to key attractions and facilities in the PA;
- visitors to miscellaneous tourism venues inside and outside the PA; and
- visitors to the SBFZ irrespective of the existence of the PA.

The various categories for which data should be collected and statistics monitored are summarized below.

3.5.1 Demographics

SBFZ, with distinction made between coastal, lowland, and coastal communities as appropriate. Wider regional demographic statistics should be collected, as appropriate, to indicate broader trends. Demographic information should be at 5 year increments, as far as possible, and concentrate on the following:

- population and growth rates;
- age structure;
- livelihood (average monthly income) and income sources (e.g. job, fishing, farming) – by area and household; and
- education levels – by area and household.

3.5.2 Economic Production

Data should include all sectors of the local and regional economy that have direct bearing on PA management. For example, the general levels of activity in agriculture, forestry, fishing/fisheries, commerce and industry could yield information indicating the following:

- opportunities for alternative livelihood and community development programs;
- where produce is likely to be derived illicitly from the PA or 'forest lands';
- where there is over-exploitation of natural resources;
- where substitutes (i.e. natural resources for harvesting, opportunities for alternative livelihood, feedstock, etc) may be available in order to redirect harmful activities;

- where growth in sustainable and 'environment focussed' economic activity exists that could assist PA management, or that the PA could enhance (e.g. the tourism and education sector) through joint ventures or complementary projects; and
- where new investment is taking place.

3.5.3 Tourism Sector

An important sub-set of economic production statistics is that relating specifically to the tourism sector. A 'tourist' can be variously defined, but is normally any person staying overnight in a locality that is 50 kilometers or more from the normal place of residence, and is visiting for other than purely work or business purposes. Day visitors are treated differently.

The design of tourism and recreational data collection and monitoring will depend, as with all monitoring, on the objectives of the exercise. It will depend on the availability of suitable data collection opportunities. This includes the existence of various tourism/recreational organizations that firstly collect information (e.g. the SBME), and secondly are prepared to make data available. It will also depend on the procedures and facilities set in place by the PAMB that will enable data to be collected (e.g. control gates, entry tolls, visitor centers, etc). The planning and implementation of such facilities in part take into account monitoring requirements.

The types of data to be collected and monitored include:
- hotel accommodation, occupancy rates and visitor origins;
- camping accommodation, occupancy and visitor origins;
- other accommodation types, occupancy and visitor origins;
- gate takings/turnstile numbers to all major/representative tourism venues in the SBFZ; and
- vehicle entries to the PA and major tourism recreational venues.

Protected Area Visitor and Use Information
There is a need to collect specific information on visitors to the PA. This includes how many, where, and the nature of the visitor experience. This includes not only what the visitor does, but nature of the 'visitor experience'. The latter is concerned with the needs and satisfaction of the visitor (qualitative factors) and is aimed at discovering how the visitor 'client' can be serviced with a better experience and more opportunities.

Various methods of qualitative information gathering and assessment are available. They include:

- surveys;
- questionnaires;

- informal monitoring (through conversation, inquiry and observation) by PA staff; and
- post departure or remote information gathering techniques.

Surveys: there are many forms of survey technique, the choice of which depends on the objectives of information gathering and the circumstances under which the survey will take place. Base-line surveys, or census, are used to gain 'benchmark' information concerning chosen (usually comprehensive) visitor data. They occur at one point in time and providing a 'snap-shot' understanding of park usage. To be useful they are repeated at regular intervals (of up to 5 years) thus allowing identification of trends. Other specialized surveys are undertaken according to research and information needs. Examples include, surveying a particular day, a particular venue, a particular type of visitor (families, school groups, overseas tourists, etc). The PAMB may also have specific survey 'targets' outside the PA. A wide variety of survey techniques are available, and there are many approaches to survey design.

Questionnaires: questionnaires are a tool used in survey work. Questionnaires broadly fall into two categories. The first are quantitative questionnaires designed to gather 'hard' data (e.g. visitor statistics). The second are attitudinal questionnaires, designed to solicit qualitative information (e.g. "how much did you enjoy your visit?" or " do you think the PA is well maintained?"). Questionnaires can be used directly or remotely (posted out or posted back). All questionnaires should be designed to meet the specific objectives of the intended survey. Professional 'interviewers' should be contracted for important or complex attitudinal surveys and the PAMB should have staff whose training includes questionnaire and survey design.

Informal Monitoring: informal monitoring of human use and activities in a 'park system' is an essential activity for PA staff. The PA is a complex system. The PA and the activities within it, will only be understood by constant observation and gaining of familiarity with patterns of use and behavior. This particularly applies to being able to anticipate or predict the outcome of various situations that may be occurring at any given time. Such knowledge often remains the personal experience of PA operatives, and hence can be lost when staff change or leave. It is vital that such 'corporate' knowledge of how the PA system works is constantly recorded, to become an important learning/training resource for new staff. Recording such information is highly dependent on the nature of the information being handled, but a combination of recorded transcripts, field notes, reports, notated photographs, video-tape, may be used.

Post departure or remote information gathering techniques: at times it will be necessary to go 'outside the PA' to gather needed socioeconomic information. One technique is to go back to recent or past visitors for information (e.g. for hindsight viewpoints, holiday patterns, etc). This can be undertaken by handing out 'post back' questionnaires, or follow up surveys by post. The latter requires gathering visitor

addresses, which is normally done only for major venues within the park where more formal entry procedures are practical. Remote information gathering techniques involve going to either targeted or non-targeted (random) interviewees. The choice and selection techniques depend largely on the intentions of the survey. The mechanisms for undertaking remote survey are also varied, but usually involve 'post-outs', telephone calls, media postings (e.g. invitations to comment), or use of internet/email. The return rate on remote surveys and questionnaires is invariably low to very low, a factor which is taken into account in both survey design and justification.

3.5.4 Visitor Information Requirements

A number of basic questions are important to ask when designing a visitor monitoring program. They include the following:

- Is there a system for recording visitor statistics in the PA? If so, is it adequate, and how could it be improved?
- How many people visit the PA each period (usually per year)? Explain estimates for years, or periods without data.
- What is the ratio of local, to national, to foreign (overseas) visitors?
- What specialist demographic information may also be useful (e.g. age, education, country of origin, reason for visiting, source of information about the PA, etc)?
- What are the high and low visitor seasons?
- What do visitors do in the PA, and what is the comparative popularity rating of activities in the PA?
- What average amount of money do visitors spend, at which venues in the PA, and what are the 'gate-takings'?
- How do visitors' responses on 'attractiveness of activities' in the park compare to the assumptions of the PAMB?
- What surveys have already been conducted and what further surveys should be conducted?
- What surveys have been conducted in other PAs, of what value were they, and is the information of relevance to the Subic Bay PA?
- What kind of promotion and marketing schemes have visitors responded to, and how/where did non-local visitors first hear about the PA?
- What visitor market does the Subic Bay PA currently serve, and what potential markets should be considered and investigated?

3.5.5 Qualitative Visitor Impact Information

Qualitative factors are difficult to define, but are good indicators of visitor satisfaction, particularly for ecotourism venues and facilities. The focus of qualitative assessment, using surveys and questionnaires as outlined above, include the following types of visitor questions/issues:

- How accessible are the facilities and attractions in the PA that visitors want to use?
- What are the most memorable experiences in visiting the PA (i.e. remoteness, wildness, views, contrast, excitement of arrival, surprise at what unfolded, etc)?
- Was there a sense of arrival?
- How easy was it to find the way through the park and visit various attractions?
- Was their information available concerning the PA and what PA had to offer, was it easy to obtain and was it any good?
- How did you rate the basic public conveniences, and were you able to access basic facilities, such as parking, shelter, toilets, etc?
- What was the quality of the ecotourism attractions in terms of the setting, condition of the surrounding environment, amenities, and overall experience on offer?
- How adequate do you consider the main visitor areas in terms of tidiness, lighting, safety, waste disposal, etc?

3.5.6 Visitor Infrastructure Information Requirement

Apart from information concerning visitors and their behavior, it is also important to monitor the adequacy of park resources and infrastructure that are essential to visitor satisfaction. Such information may be obtained from visitors through questionnaires, or surveyed separately. Information required for this purpose would include the following:

- What facilities are available in and near the PA (e.g. visitor centers, trails, parking, public conveniences, food outlets, accommodation, gift shops, signage, lodges/shelters, etc)? This requires an inventory that should be regularly upgraded.
- Are the facilities used, how frequently, by whom and when?
- What is the condition and appropriateness of the facilities? How old, how in need of repair, when does/did maintenance occur, and who is responsible?
- Which facilities provide essential information to visitors, which provided 'environmental interpretation' and education materials, and how successful are they?
- What kinds of educational materials are available in the park, and outside the park, and from where are they available, and how are they distributed?
- For whom are educational and interpretative materials prepared (i.e. who is the audience) and are they appropriate/successful?
- Which facilities in the park provide income/revenue to the PA (or concessionaires operating in the park), either directly or indirectly?
- Which facilities contribute financially to businesses operating within the PA, and to the wider economy?

- Which facilities involve a net cost to maintain, and can that cost be defrayed in anyway?

3.5.7 Protected Area Visitor Information by Management Zone

A consideration that flows from gathering information on visitor and human use patterns within the PA is the need to relate the information gathered to the principal management needs of the PA. It is therefore essential that information is collected, assimilated, analyzed and recorded in terms of the various PA management zones. This accords with one of the principal intentions of management of the PA by management zones; to order human use and visitor opportunity according to the natural resource characteristics and carrying capacity of the varied environments of the PA, which are in turn reflected in the management zone designations.

PA visitor information should therefore be gathered, analyzed and stored according to the following PA Management Zones.

SUBIC BAY PAMP MANAGEMENT ZONES	SUBIC BAY PAMP SUB-ZONES e.g. (Current and Future)
Core Ecological (terrestrial, marine)	• Bataan NP corridor • Vicinity of Hill 394
Sustainable Use (terrestrial, marine)	• Turtle nesting beach • Forest Ecosystem Corridor
Restoration (terrestrial, marine)	• Sites in Core terrestrial zone • Pastolan reforestation area
Habitat Protection (terrestrial, marine)	• Mangroves • Rivers • Cubi bat roost
Multiple-use	• (as yet unspecified venues)
Recreation (terrestrial, marine)	• Beach • Swimming • NavMag sites • Hill 394 • SBME • Pamululakin • Equestrian Center • Golf course • Grande Island
Special Use	• Vegetation protection • Park infrastructure and administration

SUBIC BAY PAMP MANAGEMENT ZONES	SUBIC BAY PAMP SUB-ZONES e.g. (Current and Future)
	• Park Information Center, Parking and Transport Terminus • Cubi Tourism Node
Buffer zones	• *Various Sub-zones*

4.0 MANAGEMENT INFORMATION DATABASE

The Management Information Base (MIB) is a tool/vehicle by which the various 'domains' of information essential for PA management are ordered and maintained. A MIB is therefore a 'library' of hardcopy documentation (i.e. reports, manuals, guidelines, policies, laws/statutes, zone tables and regulations, maps, air-photographs), electronic-copy data and information (i.e. all computer-based reports and data, etc). The MIB will also include 'scientific' artifacts and specimens recorded and kept in an appropriate manner in a laboratory and/or suitably maintained archive.

As part of the Subic Bay PAMP project, a Land Resource Information System (LRIS) database was established to collect all geographically-based information related to development of the protected areas management plan and to provide a basis for management of the SBPA. This should continue to be maintained and updated with information from monitoring activities as a powerful and cost-effective management tool forming part of the MIB.

The MIB should be kept and made available in a form suitable for rapid access to all necessary advice for guiding management decisions and actions.

A section with specially trained personnel should be given the responsibility of assembling and maintaining the MIB. In form it will therefore be a combination of library, resource center, laboratory and archive. The MIB will not be static. It will expand and evolve over time as more data is gathered and processed, and as further laws/statutes, policies, strategies and programs are developed.

The key items to be retained in an MIB at a minimum include:

1. Management zone maps and accompanying description (Volume 2, plus additional material);
2. Management zone guidelines and prescriptions (Volume 3, plus additional materials);
3. Guidelines for the Protection of Flora and Fauna Outside Protected Areas (Woodward-Clyde 2001) which contains information on:

    - laws and statutes pertaining to protection of flora and fauna;
    - possible institutional arrangements for environmental protection;
    - forest protection;
    - marine resource protection;
    - urban environmental protection;
    - rural environmental protection;
    - upland environmental protection;

- buffer zone protection;
- integrated catchment management;
- appended guidelines (miscellaneous);
- Best management practice (water sensitive urban design) guidelines; and
- Miscellaneous guidelines (e.g. erosion control, reforestation, public communication techniques, etc.
- Current list of endangered and threatened species
- Data from relevant geo-referenced sampling from Subic Bay PAMP resource inventories
- Records of enforcement and surveillance activities

4. Results of monitoring surveys

As the specific monitoring and enforcement plans are developed for the SBPA, provision should be made for the routine and orderly incorporation of relevant data on the physical, biological, and socioeconomic resources as outlined in this document.

5.0 ENFORCEMENT ACTION PLAN

Enforcement is a critical aspect of overall park or protected area management. However necessary though enforcement may be, good protected area management should practice enforcement more as a 'last resort' than a 'front-line' measure in securing acceptable behavior. Park management experience proves clearly that maintaining a constant presence of rangers and management staff in identifiable uniforms, on patrol, staffing visitor centers, aboard patrol vessels, interpreting and visibly managing all park resources has a positive impact on visitors and the wider community. In addition, a well managed environment, site or venue generally encourages visitors and the wider community to respect the area and treat the facilities with care. Good PA management therefore also saves the cost of excessive maintenance, repair and rubbish removal, etc.

The Ecology Center, through the Protected Areas Division, should develop a detailed action plan for enforcing the provisions of the SBPAMP and the Guidelines for the Protection of Flora and Fauna Outside Protected Areas. The EC is empowered to implement such enforcement as stated in PP 532, which established the SBFZ. Such actions are essential for SBPAMP implementation.

More important, a constant or frequent (both random and regular) presence of rangers and wardens in more remote areas of the PA does a great deal to dissuade poor behavior, and makes illicit/illegal activities much more difficult to carry out without being observed and apprehended.

This is based on various principles. One commonly accepted park management principle is that 'non-use (in the sense of no management or management presence) attracts mis-use'. It is well established that anti-social and environmentally harmful behavior tends to occur in direct relation to the relative absence of consistent and good management of the 'park resource'.

The general principle of influencing behavior is further strengthened by the 'extension' of other practices. For example, the use of a combination of park rangers, wardens, and security staff in the employ of stakeholder organizations, local police force, as well as the staff of the concessionaires and ecotourism operators has a strong influence on visitor perception. The involvement of an identifiably broad group of visible 'management' personnel, including members of the private sector, presents a strong impression of joint effort and common values based on protection of the environment. This can have a high educational, value changing and behavior modifying influence on visitors and the local communities.

Nevertheless, the need for fair but committed enforcement still remains. Rules without enforcement can lead to disrespect and anarchy amongst both visitors and concessionaires. In the Subic Bay context, where there are known to be illicit loggers, various criminal activities, miscellaneous abusers of the environment, poorly administered government interests, as well as operational elements of the New Peoples Army (NPA) and sundry bandits in remote forest areas, enforcement is challenging but unavoidable. In addition, there are also a significant number of adjacent communities consisting of villagers, landholders, squatters, swidden farmers that either can or do cause significant damage to the environment.

5.1 Surveillance

5.1.1 Purpose of Surveillance and Rangering

Surveillance is the act of passive observation of specific or non-specific locations, targets of activities, and recording those observations. Rangering is the term used to describe the overall function of 'patrolling', surveillance and undertaking of multiple tasks associated with the business of being a park or protected area ranger. Both involve being physically present in the environment of the PA, at all times of day/night, in all seasons and under all conditions. Tasks include any activity (within the law) that is deemed necessary by the PAMB to achieve the management objectives of the PA.

Surveillance, or rangering, is one of the most important management activities within a park or protected area. It involves moving about the PA, or designated portions of the PA, in a predetermined and methodical manner, undertaking various duties as prescribed, and observing everything of possible relevance to the management of the PA. The objectives of surveillance/rangering are to:

- undertake reconnaissance and observation over as a large area as possible over a given period of time (day, week, month);
- give an impression of constant management presence in as many key areas of the PA as possible;
- gain a working familiarity with all aspects of the PA environment, visitor facilities and human activities being conducted in the park, so that unusual and 'out of character' occurrences are immediately noticed;
- monitoring and policing all permitted activities (concessions, permits, licenses) occurring within the PA;
- constantly record new information relevant to various aspects of PA management, and to report that information back to other 'arms' of PA management (e.g. habitat management experts, maintenance staff, restoration experts, etc) in order to build the operational information/data base of the PAMB;
- be on hand and ready to take action to redress undesirable or dangerous situations; and

- be on hand to help guide, direct, advise and ensure the safety of visitors and stakeholder operators within the PA.

Ranger surveillance by management zone:
Surveillance should be undertaken in a systematic and methodical manner. This is best achieved by organizing surveillance by management zones. This makes sense due to the different environment and landscape conditions generally found in each management zone, and due to the differing items of concern and interest that will be the focus of surveillance in each zone.

For example, in the core zone, where the environment/terrain will be most difficult and restriction of human activity is the predominant prescription, surveillance will emphasize watching out for illegal activities, probably being undertaken in a secretive manner. Rangering will therefore involve a degree of 'stealth', with an emphasis on care to avoid dangerous or difficult situations (physical or social). By contrast, in the recreation or multiple use zones, where appropriate human activities are encouraged and prescribed, rangering and surveillance will be overt, constructive and interactive with PA visitors and operators.

5.1.2 Ranger Activity Requirements

Ranger requirements, as a part of the overall activity of surveillance and enforcement, involves the following considerations.

Principles of good rangering
Rangering should be carried out in a systematic and methodical way, and in a manner which suggests diligence and commitment to the job. Rangers should be constantly watchful. Uniforms and equipment should be well maintained, and all actions should be undertaken in a business like manner that conveys confidence and professionalism. By the same token, rangers should be approachable and provide a sense of security to PA visitors, rather than be authoritarian and overbearing.

Active presence
Rangers should work and move through the PA in a manner that provides visitors and others with a sense that 'rangers are everywhere' in the PA.

Raising management profile
To convey a sense that there is a management presence requires PA staff and rangers to be seen and functioning as much as possible. The active presence of rangers and other staff, in PA uniforms and marked vehicles, will raise the profile of the PAMB and convey an important sense of the management organization.

Set routines
Management and rangering in particular, should have some set routines. The regularity of certain activities conveys a sense of good organization and gives a degree of confidence to operators within the park. Important routines are the consistent 'open' and 'closing' times, rubbish removal, presence at key monitoring/control points, etc.

Patrolling
Patrolling should be done in a careful manner. It should be undertaken in a methodical and careful manner, avoiding rushing. Patrol routes, and surveillance points should vary overtime, and in accordance with seasonal changes within the environment, and in response to visitor activities and numbers.

Interacting with visitors
Rangers should not remain aloof from visitors and stakeholder operators within the PA. It is essential for PA staff to interact as much as possible in a positive manner with the community and visitors. The building of positive and constructive relationships is an important way of modifying and directing behavior, and of promoting a positive image of both the PA and the PAMB.

Assisting visitors
Most visitors, particularly first time visitors, will be unfamiliar with the layout of the PA and will not know what attractions are available, or where they are. It is therefore important for all PAMB staff to communicate with visitors of the PA. This will involve guiding, directing, reminding, informing visitors and stakeholders on a wide variety of matters, from the mundane (e.g. where the nearest public conveniences are) to important or urgent matters (e.g. the need to comply with a law or regulation, or to vacate a sensitive habitat area, etc).

Visitor safety/security
PAMB staff and rangers in particular have (within reason) a 'duty of care' to ensure the safety and security of visitors to the PA. Apart from at all times being helpful, rangers are duty bound to help visitors avoid high-risk situations. In the event that visitors are at risk, the PAMB will take action to help. This can include search and rescue of visitors who get lost, and providing assistance to visitors who are injured or hurt. Ideally, however, prevention through timely advice and guidance to avoid dangerous or high-risk situations from occurring is preferred.

Surveying, observing, recording
Successful enforcement of PA regulations involves good information based on constant observations, that are in turn well recorded. This is an essential measure for successful enforcement involving legal action against transgressors. Good knowledge and

confidence in the facts is also a powerful tool to dissuade transgressors against further illicit activity.

5.1.3 Patrolling Techniques

As part of enforcement and rangering, patrols should be undertaken in an intelligent manner with deliberate targets for surveillance. There are large tracts of land to be covered and resources will always be less than desirable for the task at hand. Hence, it is important to deploy resources and effort in such a way that a maximum degree of benefit can be gained. In general, while the rangers must cover as much of the PA as possible over a given time period, planning ranger patrols should take into account key sites for inclusion. This means using knowledge/intelligence gathered from ongoing surveillance to identify various important sites. These include:

- soft-spots – locations that are exposed to abuse or difficult to control (e.g. breaches in perimeter fencing adjacent to the urban environment);
- action spots/hot spots – places where anti-social or illegal activities are known to occur or are likely to occur;
- danger zones – sites that are intrinsically dangerous and require special care and more regular observation, especially for example during school holiday periods, or during the wet season;
- special sites/zones – sites that have known special values or sensitivity, particularly habitats or fauna breeding locations.
- optimum patrol routes – it is sensible to plan all patrols in such a way that routes take in as many important or sensitive sites as possible.

5.1.4 Stakeholder Participation

Successful enforcement of the SBPAMP and guidelines for protecting flora and fauna can only be accomplished with the support and involvement of all stakeholders. The Aeta of Pastolan have a Certificate of Ancestral Domain Title to a third of the land within the SBPA and an interest in preserving its natural resources. Local communities derive a variety of goods and services from the forest and bay, and indirectly from the mangroves, which serve as nursery areas for many marine fishes. Other stakeholders are in position to derive economic benefits from the forest and bay through ecotourism, snorkeling, diving, and other sustainable activities.

Establishment of the SBPA should prevent deterioration and loss of services to those who presently are involved in destructive fishing and other harvesting practices. This can be accomplished through implementation of the alternative livelihood strategies described in Volumes 2 and 7 of the SBPAMP. Such programs should reduce the need for enforcement.

Successful enforcement requires that stakeholders realize benefits and support protection. Indigenous communities should be directly involved. NGO support for educating and training local communities should also assist with enforcement in remote areas. Deputization of organizations such as the Coast Guard Auxiliary can help with surveillance, and involvement of locators in educational training will also help reduce the need for enforcement actions.

Above all, enforcement staff, including forest rangers, harbor patrol, and the police must not become part of the problem. They should receive training in SBPAMP restrictions and the reasoning behind them. They should be provided with adequate food so that they do not continue to hunt wildlife or fish in protected areas. They should not be subject to bribes and other forms of corruption that preferentially allow illegal practices to occur. Stakeholder can participate in providing appropriate training and support to these officials.

The Aeta

The Aeta have a key part to play in the surveillance and monitoring of the PA. Their skills in observation, tracking, stealth and surveillance within the rainforest environment are legendary. The US Navy used them to extremely good effect for exactly the same practical purposes as are required for the management of the PA. They are particularly effective in the more remote, deep forest areas.

In addition, their knowledge of the forest environment habitat is second to none. The SBPAMP project scientists engaged in the resource inventory work were able to establish that the Aeta have their own monitoring abilities (intuitive, subjective, qualitative) by which they judge changes and impacts within the environment. They are not only effective, but in practical management terms, possibly more effective than the 'one point in time' knowledge of the resource inventories.

A third consideration is that the Aeta have the strongest stakeholder interest of all groups in the future protection of the PA, quite apart from the fact that the Pastolan Aeta now have Ancestral Land Title to at least a third of the overall PA terrestrial land area. Their contribution in the field of monitoring and surveillance is therefore of inestimable and irreplaceable value.

The action plan for monitoring and surveillance should incorporate an intense program of engaging the Aeta in future ongoing management activities, and a training program developed and implemented to make use of, and benefit from, this unique resource. A host of complimentary benefits will flow from this action over time, not the least of which is to greatly strengthen and reinforce the potential 'social fence' buffer that is presented by the existence of the Pastolan Aeta community in Buffer Sub-zone 2.

Taken to its logical conclusion, the Aeta can ultimately play a key role in enforcement also. This will require training in enforcement techniques, as well as training in the regulations and laws governing environmental protection within the PA.

Fishers
Similar to the benefits offered by the Aeta in the terrestrial portion of the PA is that offered by the regional fishing community within the Bay. At present the local fishermen represent a major threat to the diminishing fish stock and fisheries of the Subic Bay marine environment. However, this same pool of considerable knowledge and familiarity with the marine environment can be turned into a widely dispersed 'monitoring and surveillance' resource to assist the PAMB.

The monitoring, surveillance and enforcement action program can therefore use fishermen to good effect. As with the Aeta, an intense program of information dissemination, recruitment of voluntary participants and training to provide the background and skills, will be required.

The logic of involving local fishermen is that ultimately, in the same way that the Aeta will be highly motivated to protect their own interests, so too will the fishermen when they understand the tangible benefits to them of habitat management, controlled harvesting, reef restocking, etc. The tendency for fishermen to become a prime monitoring and enforcement stakeholder group is well demonstrated in numerous other case study situations. Programs such as Ocean Adventure's training and their attempts to establish fish cooperatives should be encouraged.

5.2 Enforcement

Enforcement involves the physical and legal based action of preventing environmentally destructive activities, of stopping such activities once they are under way, and of taking legal action under statutes and regulations to exact fines and other penalties on transgressors.

Enforcement is a difficult, costly and at times hazardous undertaking. The PAMP has on file evidence that illegal loggers within the study area are armed with high-powered weaponry and are prepared to kill those that interfere with their activities. This is likely the most dangerous aspect of the enforcement task.

More often enforcement involves controlling and dealing with everything from poor behavior to incidental breaches of PA rules and regulations. Very often enforcement involves merely informing individuals, organizations or groups of what they are doing wrong, and requesting they stop, or do things differently.

Often the hardest judgement for enforcement officers is deciding, sometimes quickly and under pressure, what the correct action to take under a given situation. All enforcement involves finding the right balance between avoiding an escalation of a difficult situation, versus being ineffectual and ultimately powerless through taking too soft a line.

All situations are unique when it comes to enforcement, and to a large degree the suitable approach to enforcement must be worked out for the PA in question. Local cultural specifics must be taken into account (e.g. the rights of the Aeta under the law).

A number of considerations are critical to an enforcement plan, including adequate training, availability of appropriate enforcement tools (e.g., patrol boats, weapons, communications devices). These aspects must be addressed through coordination between SBPA rangers and SBMA law enforcement authorities.

Current effort such as Baywatch, the provision of boats and repair services, and enforcement surveillance should be expanded and encouraged.

Effective communication among law enforcement agencies, SBMA departments, and other stakeholders is a key factor in successful enforcement. Establishing and maintaining hotlines of communication and a SBPA website, in cooperation between the Ecology Center and other stakeholders provides a means of reporting both successes and problems (see Volume 4, EIC Program). Such communication can result in effective action.

5.2.1 Legal Provisions and Limitations

Enforcement in any situation is to a large degree controlled by the legal environment in which operations must take place. The 'by-laws' and detailed management zone regulations will dictate how enforcement staff are to make judgements on the nature and seriousness of transgressions. Common to all legal environments, however, is that it is not possible to enforce anything for which their does not exist a legally framed statement of what is right or wrong, what is unacceptable, or what is an 'exceedance' (i.e. an action going beyond a stated level of acceptability).

A summary of the applicable laws and regulations for enforcement inside the SBPA and in the surrounding area are provided in the Guidelines for Protection of Flora and Fauna Outside of Protected Areas (Woodward-Clyde 2001). These guidelines provide specific information on the applicability of various laws and regulations within management zones.

In the Subic Bay PA situation there is a need to establish the full range of enforcement parameters by which PA management will be undertaken and complied with. This

involves creating a full enforcement and regulations document, taking into account the following:

- requirements of the national laws of the Philippines that pertain to the Subic Bay PA situation;
- all regulations and statutory provisions that apply within the Subic Bay Freeport Zone;
- all legal requirements under the NIPAS and DENR pertaining to the management of the PA;
- all management zone prescriptions and guidelines that are provided in Volume 3, and subsequent SBPA by-laws and regulations that are adopted by the PAMB, for the control and enforcement of the SBPA management objectives; and
- all legally based contractual and other agreements reached with stakeholders, and operator permits approved by the PAMB and SBMA, that dictate the nature and conduct of activities within the SBPA.

The preparation of this document is a high priority for the PAMB, following establishment of the PA and the formation of the management body.

5.2.2 Techniques in Enforcement

Enforcement requires the application of trained individuals undertaking what is a highly sensitive and at times difficult task. It requires considerable skill. The PAMB should initiate, as soon as possible after establishment and recruitment of staff, an enforcement training program. The PAMB will need to draw upon other enforcement agencies and other PAs to undertake this training task.

Enforcement varies from the 'office' based enforcement of regulatory control to field enforcement requiring direct intervention with the public and illicit operators.

The former involves the procedures associated with telephone calls, documentation, letter and email correspondence, record keeping and archiving, and direct meetings. It is highly procedural, and may involve the advice and involvement of legal counsel from time to time.

The latter involves activity more akin to policing and security work. At worst it can involve direct physical conflict and confrontation where offenders are brought under control and handed over to the police. It is important to note that PA rangers and enforcement staff are not generally given the same powers as the police and, more importantly, are themselves highly accountable for their actions. It is therefore extremely important for enforcement staff of the PAMB to be well trained in their capabilities and the range of powers and appropriate/allowable actions they may take in doing their jobs.

5.3 Procedures

The key to enforcement that works legally, and that protects the PAMB enforcement staff themselves, is both proper training and very well established procedures.

Proper procedures are essential for office based 'statutory enforcement' and for 'field policing/enforcement'. In the latter case, rangers can be at great risk, and it is important to have well-established 'standing operational procedures' (SOPs) that maximize ranger safety and enforcement effectiveness. One of the most important SOPs is that which helps a ranger to decide when to back off from a situation that is too dangerous, becoming dangerous and getting out of control, or when to first request back up and assistance from other staff or the proper authorities (i.e. police).

Another area of vital procedure is that involving the documentation of any incident or situation, and in particular any incident or situation that will lead to legal action.

The enforcement action plan must establish clear procedures for all these circumstances.

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