

MEASURING EFFECTIVENESS IN MARINE PROTECTED AREAS —PRINCIPLES AND PRACTICE

*Jon Day¹, Marc Hockings² and Glenys Jones³

1 - Great Barrier Reef Marine Park Authority, PO Box 1379, Townsville AUSTRALIA, 4810 j.day@gbmpa.gov.au

2 - University of Queensland, AUSTRALIA. m.hockings@mailbox.uq.edu.au

3 - Parks and Wildlife Service (Tasmania), Department of Tourism, Parks, Heritage and the Arts, P.O. Box 44, Hobart AUSTRALIA 7001 glenys.jones@parks.tas.gov.au

Abstract

The protection of aquatic areas is a comparatively recent concept compared with the protection of terrestrial areas. The momentum for the protection of aquatic areas is increasing and all Australian States and Territories and most coastal countries worldwide now have some form of marine protected area (MPA) system with a wide variety of names, aims, objectives and intended benefits. Along with calls for more MPAs, there are growing expectations of more systematic assessment of the effectiveness of such areas. Increasingly, it is being recognised that effective resource management requires monitoring and evaluation to enable an adaptive approach to decision making.

There are compelling reasons why managers should measure the performance of protected areas, and a variety of managers are responding by seeking to objectively demonstrate management effectiveness. While there are a number of key principles for such evaluations that can be transferred to aquatic systems from approaches developed for terrestrial protected areas, practical experience in measuring effectiveness in MPAs is, as yet, limited. This paper outlines some of the approaches, experiences, issues, challenges and benefits of evaluating management effectiveness in MPAs, and suggests a range of practical considerations for those endeavouring to measure effectiveness of MPAs.

The paper concludes that management practices for MPAs generally have a long way to go before evaluation of management effectiveness becomes a well integrated component of management systems. In many cases, the establishment of appropriate programs for evaluating management effectiveness requires major institutional re-orientation at the policy level. The challenge is for MPA managers, decision makers, funders and evaluators alike to bring about the changes required to see the establishment of evaluative management systems for MPA as the norm rather than the exception.

Keywords: marine protected areas, MPA, evaluation, measuring effectiveness, objectives

INTRODUCTION

The protection of aquatic areas, and in particular marine protected areas (MPAs), is a comparatively recent concept compared with the protection of terrestrial areas. Although the oceans constitute more than 70% of the earth's surface, MPAs cover less than 1% of the earth's surface, whereas terrestrial protected areas cover some 9%. The momentum for the protection of aquatic areas is increasing and all Australian States and Territories and most coastal countries worldwide now have some form of MPAs or MPA system with a wide variety of names, aims, objectives and intended benefits.

Along with increasing calls for more MPAs, there are growing expectations for more effective management. Management in the MPA context usually includes attempts to “deal with issues of almost wholly human origin” (Walton & Bridgewater 1996) and trying to ensure that human activities do not overwhelm the resilience of natural systems. Effective resource management cannot occur without monitoring, evaluation and adaptive management. At the World Congress on Aquatic Protected Areas, held in Cairns in August 2002, the need to ‘effectively measure performance’ was considered to be of such importance that the organisers devoted one of five congress themes to it.

Worldwide there are increasing requirements for the evaluation of all management programs, and MPAs are no exception. Such evaluations need to demonstrate the effectiveness of management through evidence of results, rather than on the basis of educated guesses, ‘gut feelings’, or assurances like ‘*trust us we’re the experts*’ (Jones, 2000). In recent years, governments have placed growing emphasis on outcome-based (rather than activity-based) performance reporting, which includes measures of performance in achieving objectives or targets. However these calls for accountability and evaluation need to recognise:

- the wide variety of MPAs set up to achieve differing purposes and objectives; and
- the issue that “one size certainly does not fit all” (i.e. the approaches of managing and evaluating a multi-use MPA at the ecosystem level clearly differ markedly from those needed for a small single purpose MPA) (Agardy *et al*, in press) – and even within a multi-use park there may need to be different strategies.

Evaluation is often viewed as an ‘optional extra’; good in theory but difficult in practice. Monitoring and evaluation programs, although supported in principle, often get displaced by more ‘urgent’ (though often less important) day-to-day management activities. However, without evaluation against objectives, managers are ‘flying blind’ and lacking the necessary evidence-based feedback to learn from, and improve upon, past management approaches (Jones 2000).

Monitoring of MPAs is not new. Most monitoring programs, however, have been directed towards biological, biophysical or social aspects, and have generally been undertaken as ‘stand-alone’ monitoring or research tasks. Some of these programs assess the effectiveness of specific management actions, but few provide an integrated assessment of the overall effectiveness of the MPA or specifically monitor the key values for which the area was declared.

A range of groups/individuals around world is now investigating more integrated ways to evaluate MPAs (for example, Hockings *et al* 2000; Mangubhai, 2001; WCPA/WWF 2002). This work has largely developed as theoretical frameworks and is only now being applied in ‘real-park’ situations. Few substantial attempts have succeeded in evaluating the effectiveness of MPAs. Progress in implementing evaluation systems for MPAs is to some extent hampered by the inherent challenges presented by marine systems compared with terrestrial systems; these are discussed below.

This paper examines some of the frameworks for evaluating effectiveness that have been developed in recent years – primarily for terrestrial protected areas, but in recent years increasingly in MPAs. It also discusses various approaches and lessons learnt, and presents a range of practical considerations for those attempting to evaluate MPAs; it examines, in turn, the key elements of objectives, indicators, monitoring, reporting and adaptive management. The differing perspectives and/or responsibilities of managers, researchers, politicians, and stakeholders with respect to evaluating the effectiveness of MPAs are also discussed. The paper concludes by examining the adequacy of current practices in evaluating effectiveness of MPAs in the light of the principles and guidelines discussed in the paper.

Many of the terms as used throughout this paper are defined in Appendix 1.

REASONS FOR EVALUATING MANAGEMENT EFFECTIVENESS

The evaluation of management performance and effectiveness in MPAs may be undertaken for a variety of purposes including the following (adapted from Hockings *et al* 2000; Jones 2000; Mangubhai, 2001):

Adaptive management

- Demonstrate/determine the extent to which the objectives of management have been achieved and that measures have been implemented/complied with;
- Enable more systematic and transparent linkage between management objectives and management actions and identify gaps that can be consequently rectified;

- Provide evidence-based feedback about what's working and what's not, enabling review of management direction, priorities, resources etc for decision makers;
- Learn more about how the MPA and its management actually 'works' – including the ecological nature of the MPA, its dynamics and their interaction with management efforts;

Improving planning

- Review and prioritise MPA policies and programs;
- Provide for more informed decision-making and improvements in planning and field management for decision makers and interest groups;

Promoting accountability

- Promote openness and accountability in areas of management expenditure, resource allocation, maintenance of values and delivery of outcomes;
- Demonstrate that resources have been efficiently/effectively used to governments, funding bodies, interest groups and the public;

Encouraging appropriate resource allocation

- Reveal gaps in our knowledge and hence justify the need for additional or different resource allocations in a systematic way.

Although the above reasons argue strongly for measuring management performance, in practice, this often entails major institutional re-orientation, and poses new challenges for managers/decision makers and 'evaluators' alike.

FRAMEWORKS FOR ASSESSING PROTECTED AREAS

The WCPA Management Effectiveness Framework developed by the IUCN Management Effectiveness Task Force (Hockings *et al.* 2000) provides a general framework for the design of a system to evaluate management effectiveness in protected areas. The framework represents the main elements of the 'normal' management cycle with various linked, iterative phases. Each of the six main management elements is clarified by a simple key question (Table 1).

Hockings *et al.* (2000), Jones (2000) and Mangubhai (2001) all recognise that the first, and most fundamental, requirement for measuring performance in any type of protected area (terrestrial or marine) is to set clear objectives. Effectiveness is then measured through the processes of monitoring and evaluation against those objective(s). Jones (2000) sets out the seven key steps in the evaluative process developed for the Tasmanian Wilderness World Heritage Area (Fig. 1).

Such evaluation needs to be an ongoing process and sufficiently adaptable to incorporate new data as it becomes available (i.e. management cannot be static). It is also important in Step 3 that a range of indicators be chosen to represent each of the key desired outcomes.

Table 1 WCPA Management Effectiveness Framework for assessing management effectiveness of protected areas (Hockings *et al.* 2000)

| Elements of evaluation | Design issues | | Appropriateness of management systems and processes | | Delivery of protected area objectives | |
|---|--|--|--|-------------------------------------|--|---|
| | Context | Planning | Inputs | Processes | Outputs | Outcomes |
| Key Question | <i>Where are we now?</i> | <i>Where do we want to be?</i> | <i>What do we need?</i> | <i>How do we go about it?</i> | <i>What were the results?</i> | <i>What did we achieve?</i> |
| Criteria used to assess management effectiveness | Significance Threats Vulnerability National context | Protected area legislation & policy Protected area system design Reserve design Management planning | Resourcing of agency Resourcing of site Effectiveness of agency in implementing program Contributions from partners | Suitability of management processes | Results of management actions Services and products | Impacts: effects of management in relation to achievement of objectives, maintenance of values & abatement of threats |
| Focus of evaluation | Status | Appropriateness | Economy | Efficiency Appropriateness | Effectiveness | Effectiveness Appropriateness |

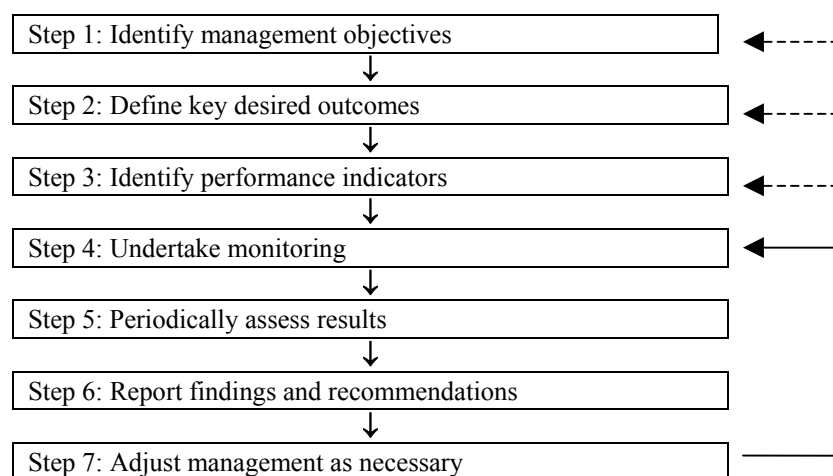


Figure 1 Seven key steps for evaluating effectiveness of management (after Jones, 2000)

SPECIAL CHALLENGES IN ASSESSING EFFECTIVENESS IN MARINE SYSTEMS

Major differences exist between terrestrial and marine systems (Slocombe, 1992), and some of these pose inherent challenges for assessing effectiveness in marine rather than terrestrial systems (Day, 2002). These differences include the following:

- the nature of marine ecosystems makes monitoring natural resources more difficult (also the volume of the sea, and hence its habitable area, is many times greater than the land);
- there is a high degree of ‘interconnectedness’ in the marine environment in all dimensions;
- a far greater proportion of the marine realm does not receive light (so photosynthesis cannot occur);
- the pelagic realm has no counterpart in terrestrial ecosystems, insofar as there are no terrestrial species (let alone whole communities) that are completely independent of the ground or ground-based resources (Day and Roff 2000);

- logistical difficulties of sampling marine systems make it much more difficult and expensive than sampling terrestrial environments – much marine monitoring and management is ‘transient’ after which researchers/managers must return to land;
- many marine species are widely dispersed and individuals can be far ranging – even among those that can be considered static as mature forms (e.g. many molluscs and seaweeds), many species have highly mobile larval or dispersive reproductive phases (Day and Roff 2000);
- marine systems are dynamic, with natural changes that differ in scale from those in terrestrial systems (e.g. marine communities respond relatively quickly to changes but within a slow-reacting and insulating ocean, whereas terrestrial communities generally respond more slowly to changes but are buffeted by rapidly changing climatic factors.); and
- knowledge of marine systems is relatively lacking. As David Suzuki said (2002), “...to date all we have actually identified are ... about 10-20% of all living things! How can we presume to manage natural resources when we have such a poor inventory of the constituents and a virtually useless blueprint of how all the components interact?”

Many of the principles for ‘measuring effectiveness’ in protected areas were initially developed for terrestrial areas (e.g. Hockings *et al* 2000; Jones 2000). However, although there are similarities, “*marine ecosystems are not simply wet salty terrestrial ones*” (Rice 1985). Many principles of marine conservation are different from those derived from experiences on land or with terrestrial protected areas. Rice (1985) observed “*The most serious problems arose when I assumed some knowledge I had gained in other contexts would transfer readily to marine contexts. It is not the case so often that one is better off assuming it is never the case, and occasionally being pleasantly surprised*”.

HOW MIGHT SUCH EVALUATION FRAMEWORKS BE APPLIED IN MPAS?

Irrespective of the purpose(s) of the MPA, the principal measure of management effectiveness is the extent to which the management objectives are achieved. Regardless of the objectives for a particular MPA, stating the objective(s) in an explicit and unambiguous way is essential to evaluate effectiveness; this applies irrespective of whether it concerns an MPA with a narrow or single objective (e.g. single-species management) or a multiple-use MPA with a broad range of environmental, social and economic objectives.

Hockings *et al.* (2000) consider the evaluation of management effectiveness for protected areas should take into account the assessment and monitoring of three broad components (as shown at the top of Table 1); for MPAs this involves the following:

- 1. Design issues of the MPA** (e.g. objectives, purposes of use and entry; hence size, shape, buffers, linkages, location of boundaries).
- 2. Appropriateness of management systems & processes** (e.g. planning approaches, management implementation, training, relationships with local communities and private sector).
- 3. Delivery of MPA objectives** (does the MPA achieve its stated goals and objectives?).

IUCN’s “*Interim Guidelines for the Assessment of Management Effectiveness of MPAs in the Western Indian Ocean*” (Mangubhai 2001) builds upon the work done by Hockings *et al.* (2000), and is particularly relevant to MPAs. However, it is still largely theoretical and its application in the field has yet to be demonstrated.

In well established MPAs, outcomes are the most important single measure of effectiveness – has the MPA really achieved its intended objectives? Issues of context, planning, inputs and processes (Table 1) are also important aspects of measuring effectiveness and can contribute significantly to an outcomes-based evaluation as well as adaptive management; however, these other elements deal more with the ‘efficiency’ aspects than with ‘effectiveness’.

For many ‘paper parks’ around the world or recently established MPAs, evaluation at the ‘context end’ of the spectrum or planning proposals is an important first step that provides understanding about

critical aspects of the management system. However, such approaches must also be followed by further assessments of the elements related to the delivery of the MPA objectives (i.e. the outputs and outcomes). A truly comprehensive system for assessing performance for an MPA would include components of all six elements as defined by Hockings *et al* (i.e. they are all complementary).

Ideally, the use of a range of approaches may be applied for evaluating management performance, i.e. measuring from a variety of information ‘angles’ such as performance indicators, stakeholder assessments and critical comment on management performance (Jones, 2000), compliance, education and environmental condition. Collectively, this provides, as far as practicable, a balanced picture of management performance.

ARE THERE OTHER EVALUATION EXAMPLES THAT MIGHT BE USEFUL FOR MPAS?

Some experience has been gained from attempts to measure effectiveness in other marine situations. For example, fisheries managers have long attempted to undertake periodic stock assessments. Most attempts, however, have examined only single-stock fisheries as outlined in the example below:

‘Effective management of a fishery requires periodic assessments of the status of the resource on which the fishery operates. Such assessments rely upon a process of stock or resource monitoring, which estimates the values(s) [sic] of one or more ‘performance indicators’ – often indices of stock abundance. Stock assessment is the examination and interpretation of a time series of performance indicator values. Translating the trends revealed by stock assessment into a specific management action can be achieved through the application of decision rules. These rules compare the performance indicators with pre-determined reference points, and if certain conditions are met, will automatically trigger certain management actions’. (Queensland Government 2001)

Such single-species approaches are rarely appropriate in the evaluation of MPAs since most MPAs are managed for multiple objectives, often including biodiversity. The single-species approach does not, for example, address matters of non-target species or the wider ecosystem processes and functions. Furthermore, biodiversity objectives are often less specifically defined than fisheries management objectives and therefore present a more challenging arena for evaluation (Syms & Carr 2001).

In addition, the focus of management strategies in many MPAs is undergoing relatively rapid change from ‘single species’ to ‘habitats’, and in some instances to ‘ecosystems’ and to a diversity of permitted uses consistent with a variety of overall objectives.

A draft Guidebook for ‘The Evaluation of Management Effectiveness of MPAs’ is in preparation by a WCPA/WWF working group based on the WCPA Management Effectiveness Framework (Pomeroy *et al.* in prep.). Some innovative work on indicators is being finalised, with the working group examining biophysical, socio-economic and governance indicators. For each category, the draft report suggests a number of specific indicators correlated with a variety of management objectives and MPA goals – however the applicability of these indicators to a wide variety of MPAs is yet to be determined.

Experience in the Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park (GBRMP) is certainly not a typical MPA in terms of its size or its complexity. After its declaration in 1975 as the world’s largest MPA, various assessments have been undertaken to evaluate specific aspects of management (Table 2). Tables 2 and 3 outline the approaches and experience gained, which may have some relevance to other MPAs.

The examples shown in Table 2 are very much task-specific, however, and collectively do not comprise a systematic evaluation of management effectiveness across the entire Marine Park. In an attempt to move toward a more holistic MPA-wide evaluation, the Great Barrier Reef Marine Park Authority (GBRMPA) is also investigating a small number of Key Performance Indicators (KPIs)

developed for the main objectives derived from the Authority's Goal (Table 3). These KPIs are not to replace any of the more detailed assessments, but rather to provide a 'broad-brush' evaluation that can be periodically assessed and reported at a MPA-wide scale.

Table 2. Examples of specific evaluation assessments undertaken in the Great Barrier Reef

| Type of evaluation | Comments | Reference |
|---|---|-------------------------------|
| State-Pressure-Response model | Summarised in the <i>State of the Reef Report</i> 1998 | Wachenfeld <i>et al.</i> 1998 |
| Day-to-day management reports | Reporting quarterly & annually against targets set for such aspects as vessel patrols | DDM, 2002 |
| Reactive Monitoring Report for GBRWHA | Report to World Heritage Committee assessed against five priority action areas; updated annually 2000-2002 | GBRMPA, 1999 |
| Effects of overflights by aircraft on nesting seabirds | A study to investigate the impacts of aircraft on seabird breeding | Hicks <i>et al.</i> , 1987 |
| Effects of sea dumping on nearby fringing reefs & seagrasses | A reactive monitoring program with decision thresholds developed to manage effects of port developments (dredging and dumping) on nearby corals & seagrasses | Benson <i>et al.</i> , 1994 |
| Environmental effects of prawn trawling in the GBR | A five-year study into the effects of trawling on seabed communities in the FNS of the GBR | Poiner <i>et al.</i> 1998 |
| Long-term monitoring of key organisms across the Great Barrier Reef | Annual monitoring of status and natural variability of populations of corals, algae, reef fishes from 48 reefs and crown of thorns starfish (COTS) from 100 reefs to assist with management decisions | Sweatman <i>et al.</i> 2000 |
| Effects of line fishing | Monitoring recovery of exploited stocks following baseline surveys & manipulations of fishing closure strategies implemented as part of the CRC Reef ELF Project | Mapstone <i>et al.</i> 2002 |
| Audit of performance of East Coast Trawl Plan | An audit of the East Coast Trawl Management Plan to examine how well the trawl fishery is managed against the ESD objectives of Queensland fisheries legislation. | GBRMPA, in prep. |
| Assessment of a new network of no-take areas against Biophysical Principles | Sets measurable objectives for 11 biophysical operating principles against which the proposed new 'no-take' network can be assessed | Day <i>et al.</i> (in press) |

Table 3. Draft Key Performance Indicators (KPIs) under development for the Great Barrier Reef Marine Park

| Authority Goal To provide for the <u>protection</u> , <u>wise use</u> , <u>understanding</u> and <u>enjoyment</u> of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park | | |
|---|--|--|
| Component of Goal | Desired Outcome | Draft Key Performance Indicators |
| Protection | Improved water quality | KPI 1 The trend in ‘end of river’ pollution loads for key Great Barrier Reef catchments |
| | Conservation of the biodiversity of the Great Barrier Reef | KPI 2 The relative numbers of reefs that are ‘healthy’ rather than ‘not healthy’ as assessed by the Australian Institute of Marine Science Long-term Monitoring Program (Sweatman <i>et al.</i> 2000) |
| Wise use | Sustainable fisheries | KPI 3 The proportion of fisheries (total fisheries v. managed fisheries) with management plans and arrangements that comply with Federal guidelines for ecologically sustainable fisheries |
| | Effective park management | KPI 4 The number of bioregions with adequate ‘no take’ zones is increasing. |
| Understanding and enjoyment | Accurate and adequate information available for management | KPI 5 The number technical and scientific publications published about the GBR by GBRMPA and the Reef CRC is static or increasing. |
| | Improved community understanding of the Great Barrier Reef Marine Park | KPI 6 Public understanding of the main threats to and the values of the GBR is increasing |
| | High-quality tourism and recreation opportunities | KPI 7 Stable or increasing numbers of tourists to the GBR Marine Park who are aware of regulatory requirements and best practice that relate to their activities. |

PRACTICAL CONSIDERATIONS WHEN EVALUATING MPAS

Some of the broader issues and lessons learnt from worldwide experience of protected areas management that may assist in evaluating MPAs are as follows.

Objectives/outcomes

a. Well-defined objectives provide a clear basis for evaluation.

Often, MPA objectives are too generalised or unclear to directly serve as a basis for evaluating effectiveness (for example “*to protect biodiversity*” is too broad to be directly measured); furthermore, this is virtually impossible to measure in most MPAs because much of the marine biodiversity still remains to be described). Mangubhai (2001) suggests that such objectives need to be clarified or restated in more practical terms, through the use of SMART objectives: Specific, Measurable, Achievable, Realistic, Time-limited.

Jones (2000) stresses the need for objectives to be articulated into clear statements of ‘Key Desired Outcomes’ that define the tangible results that would be expected if the objectives were fully realised. Such statements then provide a practical basis for evaluating management effectiveness. In addition, Jones suggests that as well as considering what outcomes ARE desired, it is often helpful to consider what outcomes would NOT be expected if the objective/s were fully realised. This step helps to clarify the polarity of outcomes that might potentially be expected, and assists in identifying appropriate performance indicators to be monitored.

b. Effectiveness needs to be evaluated with respect to stated objective(s) and targets.

The mandate of the managing agency has a significant influence on the goal or objectives of an MPA. For example, an MPA with a goal or objective for fisheries management is quite different from an MPA designed primarily to protect biodiversity or to function as a reference area. Note that the achievement of many MPA objectives is influenced by factors outside the MPA jurisdiction or not under the control of managers (e.g. the wider context of migratory

species). This can lead to difficulties both in monitoring and effective management of these factors outside the relevant MPA.

Indicators

a. It is rarely practical to monitor or measure performance indicators for every aspect of every objective

This applies particularly for complex MPAs with a multitude of objectives. Consider instead measuring a ‘key’ set of indicators that reflect significant or strategic aspects of the overall MPA and its broad objectives.

b. Indicators need to be relatively simple and cost-effective

This applies in terms of data collection, analyses and interpretation. Wherever possible, use existing programs rather than ‘re-inventing the wheel’.

c. Use input from local managers

The identification and selection of meaningful and practical indicators should rely heavily on input from those with local management knowledge and/or specialised expertise.

d. Recognise ‘shifting baselines’

When attempting to monitor change in environmental systems, be aware of the issue of ‘shifting baselines’ and avoid the potential for major problems that can arise if inappropriate reference points are assumed or improper targets are selected. As Pauly (2001) explains *“Each generation accepts the species composition and stock sizes that they first observe as a natural baseline from which to evaluate changes. This ... ignores the fact that this baseline may already represent a disturbed state. The resource then continues to decline, but the next generation resets their baseline to this newly depressed state. The result is a gradual accommodation of the creeping disappearance of resource species, and inappropriate reference points.”*

e. Have a clear focus on the ‘right’ question(s)

It is much better to have a clear focus on the right question, and apply a low power assessment program, than to apply a high power assessment program to the wrong questions. Focusing on monitoring ‘easy’ or established indicators may result in information about the wrong questions. Many monitoring programs ‘do the thing right’ (i.e. precise local measurements) rather than ‘doing the right thing’ (Walters, 1997). The best starting point for developing a sound set of indicators is to ensure that clear objectives/outcomes are defined before indicators are developed.

f. Develop socio-economic indicators

For most MPAs, there is a need to develop socio-economic indicators as well as the more usual ecological and management indicators.

g. Prioritise the needs for monitoring

Remember that the costs of conducting performance evaluation need to compete realistically alongside other demands on the budget. The level of resources applied to evaluation may be influenced by many factors. Hockings *et al.* (2000) provide guidelines on the level of effort that should be expended on evaluation based on the significance, extent of threat and level of use of the site and the capacity of the management agency.

h. Recognise the many sources of uncertainty inherent in natural systems

The challenge is to develop performance indicators and protocols that are robust to the many sources of uncertainty inherent in natural systems (Syms & Carr 2001).

Monitoring

a. Start with a modest monitoring program

It is better to start with a relatively modest monitoring program for a few key performance indicators and expand programs as guided by experience. Jones (2000) considers that priority should be given to monitoring programs that provide information:

1. about the extent to which key objectives are being achieved (or are failing to be achieved);
2. about the condition of the most significant conservation values (especially those that are perceived to be at risk);
3. that can help resolve important, complex or controversial management issues.

b. Consider what are the most appropriate monitoring methods

In some instances a combination of monitoring methods may provide better or more reliable assessments than use of just a single method.

c. Determine who is best able/suited to undertake the monitoring

Consider and clearly establish who is best able/suited to undertake the monitoring (e.g. should the program be conducted internally or externally? – there are pros & cons with each). Where possible, use MPA managers who are regularly on the water to assist with monitoring.

d. Consider opportunities for participatory monitoring and evaluation programs

Wherever possible, encourage stakeholder participation or local input in the overall evaluation process. There is also a need to develop cooperative working arrangements for monitoring with a variety of other users who may already be out in the MPA in reasonable numbers – whether they be fishers, divers, tourist operators or local volunteers. In all instances, careful training is required to ensure that monitoring data are accurate and meaningful.

e. Managers cannot afford to wait for perfect science before taking management action

So long as data are relevant and valid, there is obvious value in obtaining quick, easily accessible results rather than waiting several years for refined presentation of the findings in a scientific publication. For example, the long-term monitoring results (Sweatman *et al.* 2000) conducted by the Australian Institute of Marine Science are placed on the Internet in a readily usable format within weeks of the completion of a survey.

f. Monitor the ‘performance’ of management

The difference between the initial value and the ‘target’ of a performance indicator may be used to represent the ‘performance’ of management for the MPA and the effectiveness of management. Iterative approaches to management can then lead to continuous improvement in performance.

g. Consider innovative monitoring approaches that may be more affordable/acceptable

Development of affordable/acceptable monitoring programs for some MPA areas may involve innovation in scientific methods and approaches; for example, the Baited Remote Underwater Videos (BRUVs) to monitor fish species, abundance and size were developed by the Australian Institute of Marine Science when destructive sampling techniques were no longer acceptable in certain MPA zones (M. Cappel, *pers comm.*).

h. Consider the need for monitoring a wider context than just within an individual MPA

There is often a need to measure indicators both within the MPA and outside the MPA to determine relative changes (for example, to establish whether detected changes are due to management actions or other factors; or to determine whether the objectives of the MPA are being achieved in comparison with non-MPA areas).

Reporting

a. Reports of evaluations should be open, transparent and accessible to the community

Reports on the effectiveness of management are usually of interest to a wide range of parties including the MPA managers, other MPAs, other agencies, governments, interest groups (funding bodies, NGOs, indigenous communities) and international community programs. Reports may take many different forms: written reports/ papers are the most common, but increasingly there are moves toward the Internet and other mass media.

b. Think about the reporting requirements at the outset of project

It is important to think about the reporting requirements at the outset of project, especially the target audience and the way the report style and level of detail are to be tailored to meet their needs. Verbal reporting may be the most appropriate means for communicating the findings and recommendations of evaluations to some stakeholder groups (eg Aboriginal, local community, field staff etc). It is also important to consider the appropriateness of timing for the release of an evaluation report, especially if using the mass media.

c. Reports should be produced regularly on a timeframe that integrates with the management planning cycle (e.g. 5 yearly).

This allows the findings and recommendations of the report to influence the review of ongoing management strategies (e.g. through adjustment of the management plan for the area).

d. Identify areas where management has been performing well, as well as identifying opportunities for improving effectiveness

The inclusion of a concise summary of the key issues and opportunities for improving effectiveness identified by the evaluation can assist managers and other decision makers to improve ongoing management performance.

e. ‘A picture can paint a thousand words’

The use of photographs, graphs and other visual methods to show trends in performance is often far more effective than reams of words.

f. Consider the opportunities for developing ‘nested’ reports

One requirement for performance reporting may provide input to, or become part of, a higher level or more complex reporting requirement, e.g. consider what aspects of statutory annual reports might be used for other reports, such as five-yearly “State of the Environment” reports or six-yearly “Periodic Reports” required by the World Heritage Committee. Similarly, consider the desirability of reporting on objectives to be undertaken at different jurisdictional levels.

Adaptive management

a. Take an adaptive management approach

An adaptive management approach is essential because MPAs are dynamic natural systems, and are commonly subject to changing patterns and levels of use, technological change, social change, and political change.

b. Measurement of management effectiveness usually cannot be ‘tacked on’ to the end of a management program

Measurement of management effectiveness needs to be an integral part of the management/planning process. Aim to get monitoring, evaluation and reporting integrated as part of the periodic management/planning cycle. Most, if not all, management approaches need to be periodically reviewed and adjusted, and a successful management regime cannot be inflexible to new information.

c. Use evaluations to feed into and influence ongoing management strategies

Management processes need to be in place to allow the findings and recommendations of evaluations to feed into and influence ongoing management strategies. For example, budget

allocation and management planning processes need to formally address the findings and recommendations of any evaluation.

d. Develop strategic priorities for monitoring

The identification of critical gaps and/or uncertainties in information required for the effective management of MPAs should be one of the key inputs to developing strategic programs of directed research and monitoring (for example, GBRMPA Research Priorities, Green *et al.* 2001).

e. Evaluation systems and indicators are unlikely to be perfect when first developed

Rarely is the right information immediately available; hence the process of evaluation – like management itself – needs to continuously adapt and improve.

RESPONSIBILITIES OF MANAGERS, SCIENTISTS AND DECISION MAKERS FOR MEASURING THE PERFORMANCE OF MPAS

Managers, scientists, stakeholders and decision makers often have differing needs and priorities when it comes to evaluating and reporting on the effectiveness of MPAs (Rogers 1998). Lawrence *et al.* (2002) list a number of philosophical and practical differences between research scientists and environmental managers including time frames and primary goals, as well as their basis for decision-making, expectations and focus. Downes *et al.* (2001) refer to the interplay between science and management that “*has proved a fertile ground for mutual misunderstanding of each others’ disciplines in terms of objectives, roles and outputs*”.

There is therefore a need to collectively determine what is required of any evaluation and who is best able/suited to conduct the necessary monitoring programs and assessments, and who is responsible for reporting the findings and recommendations. There are therefore challenges for all those involved:

- Challenges for MPA managers include:
 - to clearly define management objectives and desired outcomes;
 - to clearly articulate key management issues, especially those that are causing uncertainty or controversy in management actions;
 - to secure ongoing commitment to evaluating management effectiveness from senior executives and funding bodies; and
 - to involve program managers and other key staff (evaluation needs to be a team effort, both in principle and in practice).
- Challenges for scientists include:
 - to involve managers in monitoring and convince them of the relevance of their work;
 - to focus on problems of immediate usefulness to management rather than on issues of intellectual challenge or difficulty (Cullen 1990);
 - to provide information back to managers that is in a form that can readily be used or applied; and
 - to move away from destructive sampling practices to new approaches e.g. Baited Remote Underwater Video systems, (M Cappo, pers. comm.).

All those involved also face the challenge of increasing public understanding of MPA issues, and the necessity to demonstrate to governments, funding bodies, interest groups and the wider community that public resources are being managed effectively and efficiently.

HOW WELL ARE MPA MANAGERS REALLY DOING IN EVALUATING EFFECTIVENESS?

Comparison of the current practices in MPAs with the above-mentioned considerations for evaluating effectiveness suggests that most MPAs are a fair way from achieving the full benefits of evaluation. More often, the realities differ from the principles or the preferred results:

- There are many theoretical calls for comprehensive evaluation of protected areas

- *the reality is few management agencies have implemented such systems.*
- Most efforts to date have concentrated on the ecological aspects/condition in a few selected areas
.... *few are really comprehensive evaluations of management effectiveness, and*
... *very few have included social or economic aspects.*
- Many evaluations have depended on staff from educational or research institutions
..... *very few have been conducted by or involved management staff.*
- Most management plans today refer to adaptive management and the need to monitor performance
....*day-to-day management matters frequently displace longer-term strategic monitoring and evaluation programs (see Jones, 2000). The main excuses for not evaluating effectiveness seem to be high cost, institutional barriers (Walters 1997) and lack of political support.*

While measurement of the effectiveness of MPAs is both reasonable and logical, its integration with management systems that are already in place provides significant challenges. However, if managers, decision-makers and stakeholders are serious about demonstrating and improving management effectiveness for MPAs, then measuring management effectiveness needs to be recognised as an essential component of sound conservation management.

CONCLUSIONS

There is now widespread recognition that monitoring, evaluation, reporting and adaptive management are fundamental components of effective resource and conservation management. Present national and international directions in environmental management and planning also support the evaluation of effectiveness.

Establishment of robust systems for evaluating management effectiveness of MPAs poses significant challenges for managers, decision-makers and evaluators alike, and requires major institutional re-orientation at the policy level. To achieve this:

- Management systems for MPAs need to be developed and/or adjusted so as to integrate the evaluation of management effectiveness. This includes clearly articulating management objectives, establishing appropriate monitoring programs for performance indicators, regularly reporting the findings and recommendations of evaluation, and adjusting ongoing management to progressively improve management effectiveness.
- The fundamental need for virtually all MPAs is to develop a set of clear objectives and realistic indicators against which effectiveness can be practically gauged. The lack of sufficient knowledge about MPAs, however, often prevents the setting of meaningful objectives in outcome-oriented (and hence measurable performance) language. The objective of 'protecting biodiversity' has problems as discussed above, but in reality this, together with some basic habitat information, is frequently the key aspect upon which an objective might be based for many MPAs being established in Australia. If the present state of knowledge does not allow objectives to be articulated into statements of desired outcomes, there is a need to establish interim surrogates (which initially may be relatively simplistic), together with a process for progressively improving the surrogates until the knowledge base becomes sufficient to enable meaningful statements of desired outcomes to be developed.
- Given limited resources, evaluations usually focus on providing information that is useful to management. Unfortunately, potential problems are often not accorded high priority for monitoring. Monitoring only the problems we already know about is criticised by many as 'throwing good money after bad' to prove yesterday's news, whereas what is needed are resources to detect and avert tomorrow's disasters. There is, therefore, a need to put in place a system of monitoring for the unexpected; evaluations should be focused equally on issues for management and on the main values for which an MPA was established (T Ward, *pers. comm.*). This then enables a 'safety net' to be put in place to ensure that monitoring does not miss entirely unexpected changes to the main MPA attributes (e.g. the approach to choosing marine indicators in Wart *et al.* 1998; Ward 2000).

- The findings and recommendations of evaluation must be regularly reported and presented in a manner that is understandable to stakeholders and usable by managers and other decision-makers.
- Management and/or other decision-making processes for MPAs need to respond to the findings and recommendations of evaluation in order to progressively improve the effectiveness of management, e.g. through budget allocation processes.

A critical step, therefore, is not just to set appropriate objectives, but to set in place objectives that recognise the need for use of surrogates (initially highly simplistic) and secondly, a process for progressive improvement of the surrogates so that objectives can be appropriately refined as the knowledge base improves (T Ward, *pers. comm.*).

The real test of success of any evaluation is the extent to which the findings and recommendations feed back into and bring about changes that improve ongoing management for a MPA.

We conclude that, despite the fact that what needs to be done is now well recognised, few MPAs in Australia, or around the world are adequately evaluating their effectiveness. The biggest challenge for MPA managers, decision-makers, funders and other stakeholders is to bring about the changes required to see the establishment of sound evaluative management systems for MPAs as the norm rather than the exception.

ACKNOWLEDGMENTS

The authors would like to acknowledge the work done to date by the WCPA Management Effectiveness Task Force; the East African Group of Experts on MPAs led by Sangeeta Mangubhai; the NOAA group led by Bud Ehler; the work by World Wide Fund for Nature and many others around the world addressing the issue of management effectiveness. We would also like to thank our MPA colleagues (in particular Trevor Ward, Tundi Agardy and Richard Kenchington), and those at our respective institutions for their comments and views.

The primary author (Day) particularly thanks the APA2002 Congress organisers for the invitation to prepare a paper on management effectiveness, and the assistance of the co-authors in preparing both for the APA2002 presentation and this paper.

REFERENCES

- Agardy, T, P. Bridgewater, M. P. Crosby, J. C Day, P. K. Dayton, R. A. Kenchington, D. Laffoley, P. McConney, P. A. Murray, J. E. Parks and L. Peau (in press). Dangerous Targets? Unresolved Issues and Ideological Clashes around Marine Protected Areas, in *Aquatic Conservation: Marine and Freshwater Ecosystems* [online] 2003
- ANZECC (Australian and New Zealand Environment Conservation Council). 1998. Core Environmental Indicators for reporting on the State of the Environment , a discussion paper for public comment. ANZECC State of the Environment Reporting Task Force, Canberra, July 1998.
- Benson, L. J., 1994. Introduction and Overview (in Benson, L. J, Goldsworthy, P M, Butker, I R & Oliver, J (eds) Townsville Port Authority Capital Dredging Works 1993: Environmental Monitoring Program, Townsville Port Authority, November 1994).
- Cullen P, 1990. The turbulent boundary between water science and water management. *Freshwater Biol* **24**: 201-209.
- Day, J.C. and Roff, J.C. (2000), Planning for Representative Marine Protected Areas – A Framework for Canada's Oceans. Report prepared for World Wildlife Fund Canada, Toronto.
- Day, J.C. (2002). Marine Park Management and Monitoring – Lessons for Adaptive Management from the Great Barrier Reef. in Soren Bondrup-Nielsen, Neil W.P. Munro, Gordon Nelson, J.H. Martin Willison, Tom B. Herman and Paul Eagles (eds). Managing Protected Areas in a Changing World, Proc. 4th Int. Conf. Science & Management of Protected Areas, May 2000, Waterloo, Wolfville, Canada.
- Day, J.C, Fernandes, L., Lewis, A, De'ath, G, Slegers, S, Barnett, B, Kerrigan, B, Breen, D, Innes, J, Oliver, J, Ward, T and Lowe, D (2000) The Representative Areas Program for protecting biodiversity in the

- Great Barrier Reef World Heritage Area. Proc. 9th Int. Coral Reef Symposium, Bali, Indonesia, October 2000, Vol 2.
- DDM, 2002. Day-to-day Management - Six Month Report for Great Barrier Reef Marine Park and Related Areas. Unpubl. Report to GBRMPA, 2002.
- Downes, B J, Barmuta, L A, Fairweather, P G, Faith, D P, Keough, M J, Lake, P S, Mapstone, B D and Quinn, G P. (2001) Monitoring Ecological Impacts. Concepts and practice in flowing waters. Cambridge University Press, 2001.
- Green, A, Oliver, J and Wachenfeld, D (eds). Research Priorities for Management of the GBRMP & GBRWHA 2001. GBRMPA Res. Publ. No. 73, 27 pp.
<http://www.gbrmpa.gov.au/corp_site/info_services/science/research_priorities/index.html>
- GBRMPA (1999). The Great Barrier Reef World Heritage Area - Framework for Management. Report to World Heritage Committee 1999, GBRMPA.
<http://www.gbrmpa.gov.au/corp_site/info_services/publications/brochures/protecting_biodiversity/gbrwma_management_framework.pdf>
- Hicks, JT, King BR and Chaloupka MY (1987). Seaplane and vessel disturbance of nesting seabird colonies on Michaelmas Cay. Queensland National Parks & Wildlife Service Management Report No. 1, 8pp.
- Hockings, M, Stolton, S and Dudley N (2000). Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas. IUCN World Commission on Protected Areas Best Practice Protected Area Guidelines No 6., IUCN Gland.
- Huber, D (2003). Audit of the management of the Queensland East Coast Trawl Fisher in the Great Barrier Reef Marine Park. Unpubl. Int. Report. GBRMPA, 2003.
- Jones, G. and Dunn, H (2000) Experiences in outcomes-based evaluation of management for the Tasmanian Wilderness World Heritage Area, Australia. In: Hockings, M, Stolton, S and Dudley N. 2000. Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas. IUCN World Commission on Protected Areas Best Practice Protected Area Guidelines No 6., IUCN Gland.
- Jones, G (2000). Outcomes-based evaluation of management for protected areas – a methodology for incorporating evaluation into management plans. In: The design and management of forest protected areas: papers presented at the Beyond the Trees conference. 8-11 May, 2000, Bangkok, Thailand WWF, Switzerland, p. 349-358. <http://www.panda.org/downloads/forests/beyondthetrees.pdf>>
- Lawrence, DR, Kenchington, R.A. and Woodley, S. (2002) The Great Barrier Reef – Finding the right balance. Melbourne University Press, 2002.
- Mangubhai, S. (nd) Interim Guidelines for the Assessment of Management Effectiveness of Marine Protected Areas in the western Indian Ocean. Report produced for IUCN supported by NORAD. 37 pp.
- Mapstone, B.D., Campbell, R.A. and Smith, A.D.M. (1996). Design of experimental investigations of the effects of line and spear fishing on the Great Barrier Reef. CRC Reef Research Centre Technical Report No. 7, Townsville; CRC Reef, 86 pp. <http://www.reef.crc.org.au/publications/techreport/TechRep7.html>
- Pauly, D. (2001). Importance of the historical dimension in policy and management of natural resource systems. Proc. Of INCO-DEV International Workshop on Information systems for policy and Technical Support in Fisheries and Aquaculture. Los Banos, Philippines, June 2000. ACP-EU Fisheries Research Report pp. 5-10; 2001; European Commission.
- Poiner, I, Glaister, J, Pitcher, R, Wassenberg, T, Gribble, N, Hill, B, Blaber, S, Molton, D, Brewer, D, and Ellis, N (1998). Final Report on the Effects of Trawling in the Far Northern Section of the Great Barrier Reef: 1991 – 1996, CSIRO Division of Marine Research, Cleveland, 565 pp.
- Pomeroy, R S, Parks J E and Watson, L M (in prep.) How Is Your MPA Doing? – A Guidebook. Working Draft, Version 31 December 2002. WCPA Marine, IUCN.
<<http://effectivempa.noaa.gov/docs/dguidebk.pdf>>
- Queensland Government (2001). Spanner Crab Fishery, Annual Quota Determination, June 2001-May 2002. In: Ecological Assessment Queensland Spanner Crab Fishery (Attachment 2 Spanner Crab Fishery, Annual Quota Determination, 2001). Unpubl. Report for Environment Australia, August 2001.
- Rice, J. (1985). New Ecosystems present new challenges. In: Marine Parks and conservation: challenge and promise (Vol 1), the National and Provincial Parks Association of Canada, Henderson Park Book Series No. 10.
- Rogers K. (1998). Managing Science/Management Partnerships: A Challenge of Adaptive Management. Conservation Ecology [online] 2(2). <http://www.consecol.org/vol2/iss2/resp1>
- Slocumbe, D S. (1992). Environmental Monitoring for Protected Areas: Review and Prospect. *Environ. Monit. Assess.* 21: 49-78
- Suzuki, D (2002). Media report by David Suzuki (reported on Environmental News Network, 14 February 2002).
- Sweatman, H., Cheal, A., Coleman, G., Fitzpatrick, B, Miller, I., Ninio, R., Osborne, K., Page, C., Ryan, D., Thompson, A. and Tompkins, P. (2000). Long-Term Monitoring of the Great Barrier Reef, Status

- Report No. 4, Australian Institute of Marine Science, Townsville, Australia.
<http://www.aims.gov.au/pages/research/reef-monitoring/lrm/mon-statrep4/statrep4.html>>
- Syms, C and Carr, MH. (2001). Marine Protected Areas: Evaluating MPA effectiveness in an uncertain world. Scoping paper prepared for North American Commission for Environmental Cooperation workshop, 1-3 May 2002, Monterey, California USA.
http://www.biology.ucsc.edu/people/carr/Syms/syms_pdfs/syms_carr_MPA_scoping_paper.pdf>
- Wachenfeld, D, Oliver, J & Morrissey, J (eds) (1998). *State of the Great Barrier Reef World Heritage Area 1998*. Report publ. by GBRMPA. http://www.gbrmpa.gov.au/corp_site/info_services/publications/sotr/
- Walters, C. (1997). Challenges in Adaptive management of riparian and coastal ecosystems. *Conser. Ecol.* 1(2):1 <<http://ns2.resalliance.org/pub/www/Journal/vol1/iss2/art1/>>
- Walton, D & Bridgewater, P. (1996). Of Gardens and Gardeners. *Nature & Resources*, 32 (3):15-19.
- Ward, T J, Butler, E, and Hill, B (1998). Environmental indicators for national state of the environment reporting – Estuaries and the Sea, Environment Australia (Environmental Indicator Reports), Department of Environment, Canberra.
- Ward, T J (2000). Indicators for Assessing the Sustainability of Australia's Marine Ecosystems. *Mar. Freshw. Res.* 51, 435-446.

APPENDIX 1

Key terms as used in this paper are clarified below:

- adaptive management** – a structured process of continuously improving management performance through “learning by doing and measuring”. However it should involve more than just monitoring and responding to unexpected impacts and should include the application of dynamic models that attempt to make predictions about the impacts of alternative policies (Walters, 1997).
- evaluation** – the careful consideration of evidence that allows for informed judgement to be made of the performance of management against some predetermined criteria (usually a set of objectives, goals, targets or standards), normally based on the measurement of performance indicators.
- indicators** - a measure (quantitative or qualitative) that is indicative of the condition of some aspect of the system as a whole (ANZECC Task Force, 1998).
- management (of MPAs)** – the sum of all decisions and actions that relate to the achievement of the purposes and objectives of the MPA. Management in the MPA context usually includes attempts to “deal with issues of almost wholly human origin” (Walton & Bridgewater 1996) and trying to ensure that human activities do not overwhelm the resilience of natural systems
- management effectiveness (of MPAs)** – the extent to which an MPA has achieved its objectives. A comprehensive assessment of management effectiveness includes consideration of: the appropriateness of design of the MPA;
- the appropriateness and adequacy of management systems & processes; and
 - the extent to which the MPA objectives have been delivered and values maintained (Hockings et al, 2000).
- monitoring** – the process of repeated observations for specified purposes, using comparable standardised data collection methods according to a prearranged schedule in space and time (Meijers, 1986). As discussed by Hockings et al (2000), monitoring can address far more than the state of the external physical and social environment and, in the context of this paper, can address the activities and processes of management.