Chapter 22
indicators

Marc Hockings

Natural Values

Cultural Values

Economic Values

Social Values

Recreational Values

It is not practical to directly measure the condition of all the attributes of a protected area (either the condition of the environment itself or other attributes, such as social and economic values). Environmental indicators provide a mechanism for tracking changes in these attributes by allowing the selection of a limited number of representative measures that are indicative of the condition of the system as a whole (ANZECC 1998). The selection of priority issues, and hence indicators, for monitoring should be guided by an understanding of the natural, cultural, recreational, social and economic values of the area and the key processes that sustain these values.

The selection of indicators is a complex process, often involving trade-offs between partially incompatible attributes. As Bernstein (1992) points out,

> [D]eveloping indicators that successfully reflect ecological effects and are managerially useful requires reconciling two sets of often conflicting constraints [that] emerge from the separate ecological and management contexts that indicators must be responsive to.

"The selection of indicators is a complex process, often involving trade-offs between partially incompatible attributes."

Key attributes of useful environmental indicators have been identified by various authors (eg Centre for Coastal Management 1993, Briggs et al 1996, Abbot and Guijt 1998, ANZECC 1998). They suggest that, to the greatest extent possible, indicators to measure management effectiveness should:

- reflect a valued element of the system or an important management issue;
- have an unambiguous, predictable and verifiable relationship to the attribute being assessed;
- be scientifically credible;
- be sensitive to change in the attribute being assessed;
- integrate effects over time and space (that is, reflect enduring change rather than short-term or localised fluctuations in conditions);
- reflect changes and processes of significance to management (including biophysical, social, cultural, economic, political and managerial attributes);
- reflect changes at spatial and temporal scales of relevance to management;
- be cost-effective in terms of data collection, analysis and interpretation;
- be simple to measure and interpret; and
- be able to be collected, analysed and reported on in a timely fashion.

It is important that data collection programs for the selected indicators be sustainable in terms of budgets and staff skills. Simple indicators are generally preferable to complex ones. If assessments are to be reported widely, the extent to which indicators are understandable by the nonspecialist is also a consideration.

A framework for organising and presenting information on indicators

The World Conservation Union (IUCN) World Commission on Protected Areas (WCPA) has developed a framework for evaluating the effectiveness of protected area management (Hockings et al 2000). The WCPA framework provides a basis for the design of evaluation systems and the identification of relevant indicators that can be measured through monitoring programs. The framework is based on the premise that the process of management starts with establishing a vision for the area (within the context of the status of existing values and pressures), progresses through planning and allocation of resources and, as a result of management process and actions, eventually produces a set of products and outcomes.

Assessment should ideally look at all aspects of the management cycle, including the context (current status of values and pressures) within which management takes place. It requires both monitoring and evaluation at various stages, each with a different type and focus of assessment.

Figure 22.1 presents the management cycle that underlies the WCPA framework.

Figure 22.1 The protected area management cycle and evaluation

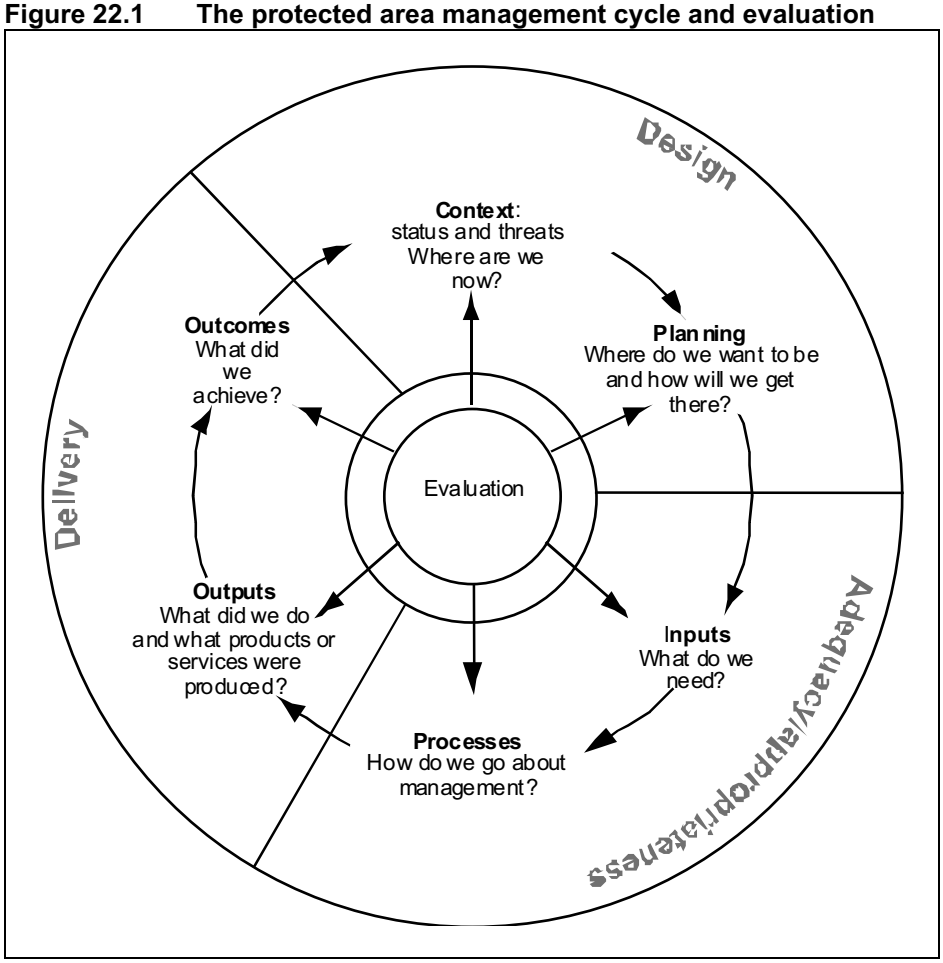

Table 22.1 sets out each of the framework elements (context, planning, inputs, processes, outputs and outcomes), explains the issues covered within each element, and lists some of the criteria that can be used to evaluate each element. Indicators are selected to enable assessment of each of the criteria specified in the framework.

The 1988 ANZECC (Australian and New Zealand Environment and Conservation Council) report on core environmental indicators points out that while frameworks are important for organising and presenting information and defining the range of issues to be considered, they are less critical for selecting indicators. The WCPA framework was not used directly in the initial designation of indicators; it has been used here to organise and present the indicators in relation to each of the values. The indicators have been selected by each of the members of the Independent Scientific Committee according to their area of expertise and the values and pressures that they assessed. Most indicators therefore relate to the outcomes element of the WCPA framework (that is, they can be used to assess the extent to which values have been maintained or pressures abated).

Table 22.1 WCPA framework for assessing management effectiveness of protected areas and protected area systems

Element of evaluation	Design issues		Appropriateness of management systems and processes		Delivery of protected area objectives	
	Context	**Planning**	**Inputs**	**Processes**	**Outputs**	**Outcomes**
Explanation	*Where are we now?* Assessment of importance, threats and policy environment	*Where do we want to be?* Assessment of protected area design and planning	*What do we need?* Assessment of resources needed to carry out management	*How do we go about it?* Assessment of the way in which management is conducted	*What were the results?* Assessment of the implementation of management programs and actions; delivery of products and services	*What did we achieve?* Assessment of the outcomes and the extent to which they achieved objectives
Criteria that are used to assess management effectiveness	Significance Threats Vulnerability National context	Protected area legislation and policy Protected area system design Reserve design Management planning	Resourcing of agency Resourcing of site Contributions from partners	Suitability of management processes	Results of management actions Services and products	Impacts: effects of management in relation to objectives

Table 22.2 Suggested values and indicators

Value	Indicator	Notes	Priority	WCPA framework element
Earth science				
	Specific objectives for management of geological features need to be set in the management plan before any monitoring needs can be identified. The geological features themselves are robust and do not require specific monitoring.			
Karst				
Cooleman Plain	Extent of weed infestation and feral animal disturbance	Mapping of weed infestation (biannual); patrol reports of feral animal sightings/damage	Medium	Outcome
	Visitor impacts around Blue Waterholes environs	Rapid mapping of visitor-use area campsites, fireplaces and tracks (resurvey biannually)	Medium	Outcome/output
	Visitor impacts in Murrays, Cooleman and Barbers Caves	Photomonitoring points in caves	Medium	Outcome
Yarrangobilly	Extent of weed infestation and feral animal disturbance	Mapping of weed infestation (biannual); patrol reports of feral animal sightings/damage	High	Outcome
	Visitor impacts around Yarrangobilly Village	Rapid mapping of visitor-use area campsites, fireplaces and tracks (resurvey biannually)	Medium	Outcome
	Visitor impacts in wild caves	Cave inspection report to be completed by cavers visiting sites; photomonitoring of sites	Medium	Outcome
	Visitor impacts in show caves	Cave inspection report to be completed by staff	Medium	Outcome
Indi	Visitor impacts in caves	Photomonitoring points in caves	Medium	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
Natural flora				
Alpine vegetation	Condition and species composition of tall herbfield, sod tussock grassland and heath	Maintain existing transects and resurvey every 5 years (survey midsummer)	High	Outcome
		Establish new transects in sensitive vegetation communities (eg snow patch) to assess long-term change in species composition and abundance (5 years)	Medium	Outcome
Subalpine vegetation and frost hollows	Condition and species composition in a range of subalpine habitats	Relocate existing transects in Guthega catchment and establish new sites (plots) as necessary (especially in frost hollows)	High	Outcome
	Change in vegetation structure	Fixed photopoints (perhaps established at sites of existing historical photos); rephotograph biannually	Medium	Outcome
Lower Snowy Valley habitats	Condition (density and structure) and species composition in cypress pine – white box communities	Remeasure existing plots and transects every 10 years	High–medium	Outcome
Upper slope and inverted tree lines	Proportion of original tree line that is structurally intact	Monitoring is dependent on establishing a baseline of the presumed extent of the original tree line; resurvey tree line (using satellite imagery) every decade	Medium	Outcome
Eucalypts from tree line to sea	Proportion of old growth eucalypt forest and woodland to total forest and woodland	Dependent on data for areas outside National Park estate	Low–medium	Outcome
	Weed and feral animal invasion of forest and woodland	Cover/abundance for weed species and signs of feral animal disturbance in fixed plots; could be undertaken as part of monitoring program proposed for subalpine vegetation)	High	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
Aquatic values				
Lakes	Benthic invertebrate fauna	Community composition assessed at 5–6 sites/lake once every 5 years	High	Outcome
	Water quality	Conductivity, pH and chlorophyll a or nutrient levels	Medium–low	Outcome
Streams and rivers	Ratio of observed taxa to expected taxa	Use AUSRIVAS model, establish permanent survey sites, monitor spring and autumn each year	High	Outcome
	Water quality	Conductivity, pH and nutrient levels	Medium–low	Outcome
Fauna				
Alpine and subalpine fauna	Condition of populations of selected threatened or significant species/communities.	Mountain pygmy-possum, southern corroboree frog, alpine tree frog, bogong moth (including arsenic); invertebrate grazing community in alpine grassland	High	Outcome
Tall wet forest fauna	Condition of populations of selected threatened or significant species/communities	Tree-hollow dependent birds (owls) and mammals	High	Outcome
		Woodland/dry forest bird communities (surveillance/baseline); link to broader studies	Medium (strategic)	
		Specialists — smoky mouse, spotted tree frog, brush-tailed rock wallaby, cave communal breeders (bats)	High	
General terrestrial habitat	Condition of vegetation type (area and condition of habitat) and percentage of mature seral stage	Need to establish measure of vegetation condition, benchmark at pre-European condition and correlate faunal communities; permanent plots established in major habitat types and resurveyed approximately every 3–5 years	Medium	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
Restoration of pre-European meso-predator system	Density (condition) of dingo and fox populations	Need to establish integrity of dingo population — will require landholder liaison; *Mastacomys* populations may be a good response indicator for density of fox above the snow line	High	
	Density and extent of quoll population			
	Fox and cat density (above snow line)			
Natural landscape				
Physical ecosystem processes	Proportion of area of park with fire regimes within appropriate range	Best-guess ranges of appropriate fire frequencies should be established for the ecosystems of the park; on-ground monitoring of biotic responses to fire will also be necessary to allow adaptive management (ie shifting of the ranges of appropriate fire frequencies in response to increasing knowledge)	High	Outcome
Wilderness	Wilderness quality index for areas within designated wilderness areas	Reassess wilderness quality every 5 years	Medium	Outcome
Natural aesthetics	Disturbance to view fields	Using method of Kirkpatrick (1979); resurvey approximately every 5 years Need to define standard sites for regular sampling; target sampling sites to development areas and add new sites in association with any developments in previously undisturbed areas of the park	Medium	Outcome
Cultural heritage				
Aboriginal history and heritage	Extent to which cultural heritage management prescriptions are being implemented	Management programs and monitoring of implementation need to be conducted in association with the Aboriginal community	High	Process and output
	Condition of Aboriginal cultural heritage sites	Need to select a sample of most significant sites for monitoring	High	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
Pastoralism	Condition of homesteads, huts and associated structures	Need to select a sample of most significant sites for monitoring (eg Currango)	High–medium	Outcome
Mining	Condition of mining heritage items	Need to select a sample of most significant sites for monitoring	Medium	Outcome
Logging, timber extraction and silviculture	None recommended			
Water harvesting	Condition of huts associated with the Snowy Mountains Scheme	Need to select a sample of most significant sites for monitoring	High–medium	Outcome
Science, research and conservation	None recommended, although established monitoring sites may form the basis for ongoing monitoring programs looking at other values			
Recreation	Dealt with as a value under Tourism and recreation, below			
Social values				
	Development of indicators for monitoring of communities and their perspectives/attitudes is dependent on more clearly characterising park communities and their attributes. Monitoring related to park visitors is addressed under Tourism and recreation, below.			

Value	Indicator	Notes	Priority	WCPA framework element
Economic value				
	Quantity of power provided to the national grid by Snowy Hydro Limited	Available from Snowy Hydro Limited		
	Volume of water contributed to the Murray and Murrumbidgee systems			
	Annual traded price of that water			
Economic value of tourism				
International tourism	International visitor nights by season	Data available from Bureau of Tourism Research	Medium	Output
National tourism	National visitor nights by season	Data available from Bureau of Tourism Research	Medium	Output
Economic input to region	Economic value of tourism to the state assessed through periodic economic impact studies	Research methodology should be kept consistent with previous studies; resurvey approximately every 5 years	High	Outcome
Tourism and recreation				
Biological and physical setting	Monitoring of condition of biological and physical setting undertaken through the indicators specified, in relation to values such as fauna, flora, aquatic habitats, wilderness and cultural values	Notes on monitoring techniques and frequencies given under relevant headings above	Various	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
	Impacts of recreational use on specific components of the natural and cultural environment	Need to select sample of high-use sites, sensitive sites and particular recreational activities as basis for impact monitoring studies	High–medium	Outcome
Social setting — visitor use and recreation (see 'Economic value of tourism' for economic aspects of visitor use)	Visitor numbers	Standard methods for assessing visitor numbers in protected areas are available. Standard instrument for visitor survey should be used. Data from surveys can be used to determine recreation market segments using park, market niches, distribution of visitor use, activities undertaken by visitors, experiences gained, satisfaction with facilities and experiences. Sampling required at different times of the year to detect seasonal differences and conducted every 5 years and coordinated with private operators.	High	Output
	Visitor profiles (visitor characteristics and motivations		High	Output/outcome
	Visit characteristics (activities undertaken, length of stay etc)			
	Visitor experiences and satisfaction			
Management setting	Condition of assets relative to setting	Need to compile register of assets and determine appropriate condition standards for particular recreational settings	Medium	Outcome
	Condition of recreational opportunity settings relative to setting standards	Need to define standards of settings in terms of relevant parameters (crowding, extent of infrastructure, nature of regulation, methods of access etc)	High	Outcome
	Impacts of use	Relevant measures of impacts of use include energy use reduction, greenhouse gases reduction, solid waste reduction, liquid waste reduction and disposal, potable water reduction, hazardous waste management, local employment, noise reduction, and supplementary indicators (these may be chosen to suit Kosciuszko). See 'Biological and physical setting' for impacts of tourism and recreational use on the park's biological and physical environment	High	High

Recommendation

As part of the process of completing the management plan, it is recommended that the National Parks and Wildlife Service add additional indicators relating to the other elements of the WCPA framework. Specification of some of these indicators will have to await the completion of a draft of the management plan, as they will relate to the specifics of objectives and strategies in the plan. The general nature of these indicators can be outlined now.

Context

The Independent Scientific Committee report identifies the significant values of the area and the pressures (threats) acting on these values. The status and trend, both of values and pressures, should be monitored as part of the outcomes component of the monitoring program.

Planning

As part of the preparation of the management plan, the adequacy of existing general protected area legislation and policy should be assessed. Similarly, the plan should contain an assessment of the strengths and weaknesses in the design of Kosciuszko National Park. Any deficiencies in design can then be addressed through acquisition or adoption of relevant management strategies. This design assessment should be conducted in relation to the major park values identified in the Independent Scientific Committee report. The new management plan should also assess current issue-oriented planning documents and identify requirements for development or review of subordinate plans.

Inputs

As a minimum, a structure should be developed for monitoring the allocation of resources (staff and funds) to major aspects of park management. Ideally, there would also be a parallel process for identifying needs in relation to each aspect of management, so that some assessment of adequacy of resourcing can be undertaken.

Processes

Evaluation of the appropriateness of management processes requires that a set of relevant management standards be prepared as a basis against which the assessment can be made. The preparation of the management plan provides an ideal opportunity for establishing such a set of standards. Existing consultative mechanisms set up for the plan's preparation could be used to get stakeholder input to the standards. Evaluation can be undertaken by scoring current management practices against the ideal standards, with assessments repeated every 1–2 years to track progress in management practices.

Outputs

The preparation of the management plan also provides an opportunity to develop a system for monitoring later implementation of the plan. This can be done using a simple database that lists the policies and actions proposed in the plan and provides for annual recording of the status of implementation of each. Additional fields characterising the nature of the policies and actions would allow more sophisticated analysis of trends in plan implementation.

Indicators of key work program outputs should also be monitored. The selection of attributes to be monitored should be made as part of the planning process, but preference should be given to those management activities

that relate to the maintenance of park values or the abatement of threats (eg completion of annual burning programs). Other output indicators that should be monitored are key demand indicators that reflect external demands placed on the staff managing the park (eg visitor numbers).

Outcomes

Indicators for monitoring the status of identified values and the abatement of threats are specified in Table 22.2. Additional monitoring of key management plan objectives should also be undertaken, indicators for which will need to be specified as part of or following the development of the management plan.

References

Abbot J and Guijt I (1998). *Changing views on change: participatory approaches to monitoring the environment*. International Institute for Environment and Development, London.

ANZECC (Australian and New Zealand Environment and Conservation Council) (1998). *Core environmental indicators for reporting on the state of the environment: discussion paper for public comment, July 1998*. State of the Environment Reporting Task Force, ANZECC, Canberra.

Bernstein BB (1992). A framework for trend detection: coupling ecological and managerial perspectives. In: McKenzie DH, Hyatt DE and McDonald VJ (eds), *Ecological Indicators*, Elsevier Science.

Briggs D, Tantram D and Scott P (1996). *Improving information for management and decision making in national parks*. Final report to the Countryside Commission. Nene Centre for Research, Northampton, United Kingdom.

Centre for Coastal Management (1993) *Monitoring the efficiency and effectiveness of the Wet Tropics Management Plan*, The University of New England–Northern Rivers, Lismore.

Hockings M, with Stolton S and Dudley N (2000). *Evaluating effectiveness: a framework for assessing the management of protected areas*. Phillips A (ed), Best practice protected area guidelines series, No. 6. IUCN, Gland, Switzerland.

Kirkpatrick JB (1979). *Hydro-Electric Development and Wilderness in Tasmania.* Department of Environment, Hobart.