New Viewpoints in Australian Outdoor Recreation Research and Planning

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11 Managing Impacts: Measurement and Judgement in Natural Resource Management

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Introduction

Managers of natural resources, from forests to fisheries, are increasingly interested in the prediction and control of the perceived impacts of utilisation on the condition of the resource. The current concern with sustainable development is stimulating this nascent interest, as is the interest in setting standards for environment parameters such as air and water quality. This chapter describes a general approach to dealing with this problem and applies it to the particular circumstances of managing the recreational use of natural areas, such as national parks.

A belief in the possibility of planning the control of environmental impact assumes that environmental management is the consequence of a rational decision making process. Models of such a process abound (Figure 11.1), most of them related to theories of management by objectives and emphasising the importance of information in the decision making process. Models, however, are abstractions of a more complex reality. Management is a blend of rational analysis and the politics of the possible in which quantitative and qualitative data vie with bureaucratic and political considerations in the formulation and implementation of public policies. Facts and measurement must find their place alongside opinions, values and judgement in the management of impacts on the public environment (Stretton, 1978, 3-18; Caley, 1980; McCool and Stankey, 1986).

A more satisfactory model of how environmental planning decisions get made and implemented needs to incorporate the influence of these bureaucratic and political values on the definition of environmental problems, the design of processes for their resolution and the solutions generated by those processes. The search for such a model provides the context for this chapter. The chapter itself focuses on specifying a process for the technocratic, rational component of environmental management. The process model should not be treated as some form of optimising technique which can generate 'Right Answers' from objective facts. The model deals with the rational component of planning which has to be blended with the political and bureaucratic components: it is an improved measuring tool to guide the informed judgement of resource managers and the public.

Figure 11.1 A Rational Planning Model

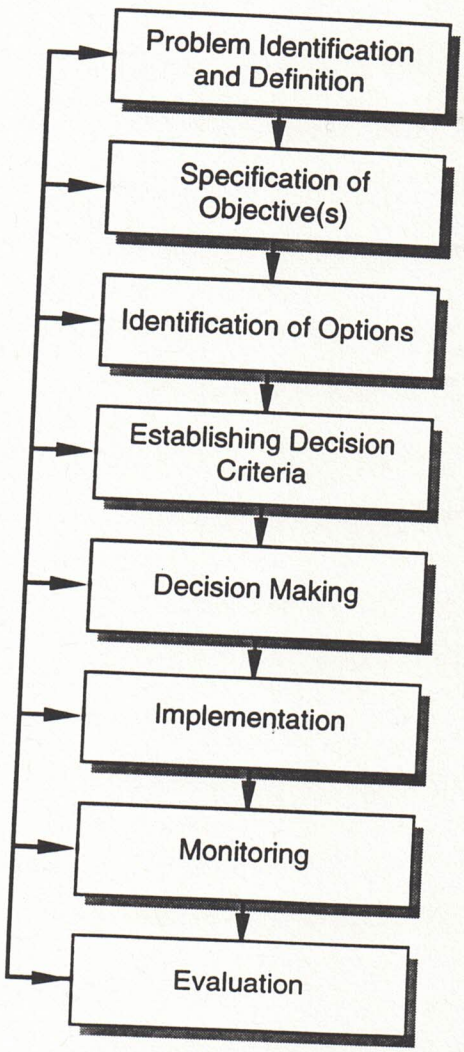
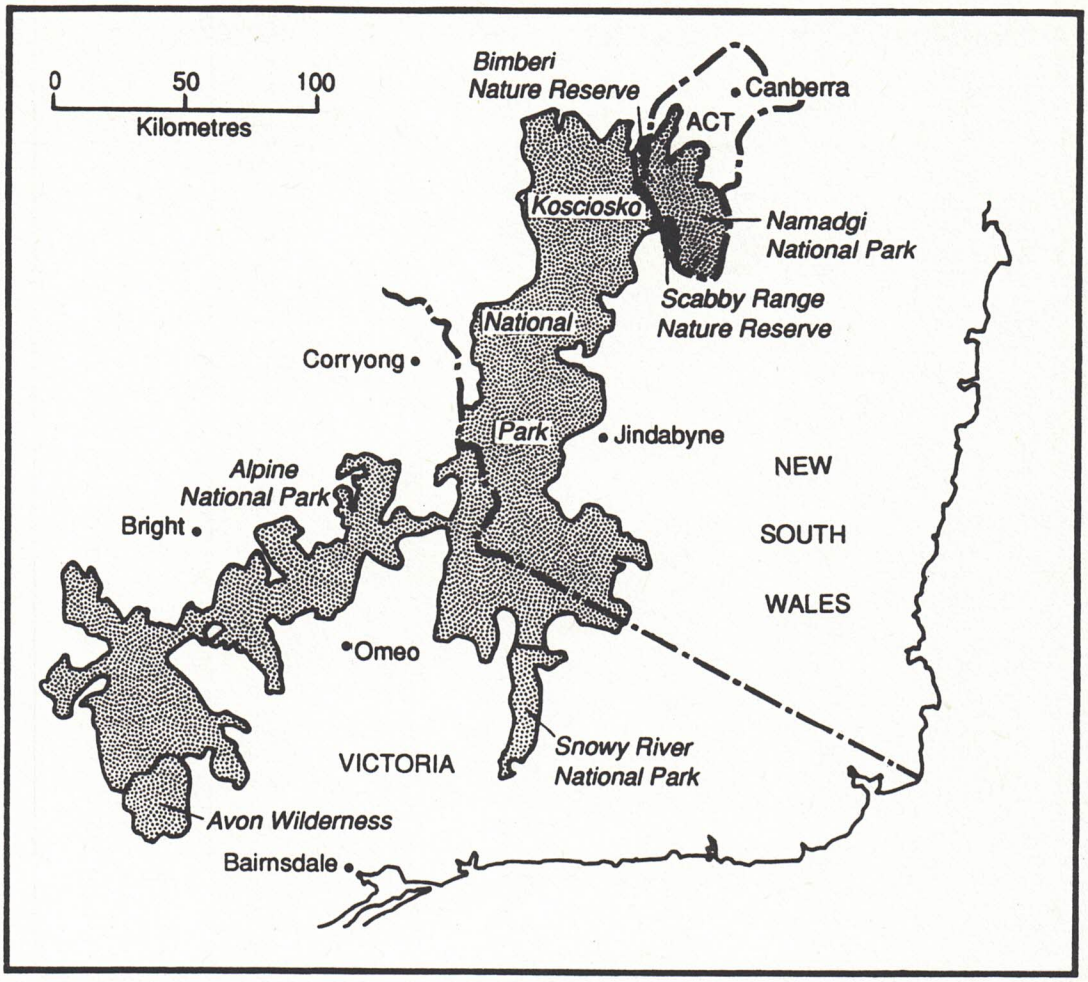


Figure 11.2 National Parks and similar natural areas in the Australian Alps of south-eastern Australia



The logic of the argument is based on a 'problem driven, data based' conception of the rational component of environmental planning and management (Turner and Sheppard, 1983). The specification of problems to be solved drives the planning process, including the collection and analysis of data which provide a basis for problem solving planning decisions. This planning model can be contrasted with, for example, 'information driven' or even 'information free' planning!

The issues addressed in this chapter have arisen from a concern with the application of environmental impact control in *management* as well as planning, and particularly in management planning by national park and other natural area management agencies in Australia. Hence, the chapter advocates the application of a particular problem driven, data based approach to the management of recreation impacts in national parks and similar natural areas in the Australian Alps of south-eastern Australia (Figure 11.2). The model has a more general application, not only in geographical terms but also to a much broader range of natural resource management issues where there is an assumption that management can be based on an assessment of the trade-offs between the social benefits and environmental costs of different forms of use of specified resources. The underlying logic of the approach is similar to that, for example, which has stimulated attempts during the late 1980s and early 1990s to set Australian standards for air and water quality.

The chapter explores:

- problems with traditional approaches to recreation planning, using catchment management in the Australian Alps as a particular example;
- the emergence of an alternative approach to recreation planning and management; and
- a model of an 'impact management process' for recreation planning and management.

Some general conclusions are drawn for the use of environmental impact assessment in rational approaches to environmental planning and management and the stimulus this approach could provide for further research in recreation and other impact management.

Planning and recreation

Management texts discuss planning as an essential function of successful management. Yet some Australian resource management agencies have shown an unfortunate tendency to confound planning with the discipline of town planning and have been slow to appreciate the benefits of planning their management programs. Part of the explanation is that planning is in some disrepute in Australia because planners often seem to lack both knowledge of how our present actions determine the future and power to ensure socially desirable actions. Planning thus becomes simply listing the things we would like to see but do not know how to achieve (Sorensen and Cullen, 1986). This is more a product of modern technocracy, which underplays the importance of values in decision making, than anything uniquely Australian (O'Riordan, 1976). Another part of the explanation lies in the low priority afforded to planning in public agencies under intense pressure to allocate their scarce resources to activities with short, rather than medium to long, term benefits. It would be an interesting study to examine the trends in resources applied to planning in Australian natural resource management agencies over the past twenty years or so.

Public planning should be at its most effective in the *planning of management* by agencies (such as Australian national park managers) whose 'ownership' of the resource they are planning should give them greater knowledge and power than is available to town planners, who have to rely on attempts to control the development of resources they do not manage. Most state, territory and Commonwealth park management agencies are required to produce management plans for individual areas under their control and there has been a significant growth in the number of such plans published since about the mid-1970s. Yet much of the recreation planning in these area plans has been less than successful in meeting either management or community expectations. The concerns about recreation most often expressed by conservation interest groups and park managers relate to the damage that it might inflict on natural areas. It would be sensible, therefore, for planners to focus on this damage (the effect) rather than the type of use (which may or may not be the real cause).

The traditional recreation planning approach, however, has been an attempt to classify recreation *activities* into 'acceptable' and 'unacceptable' categories, with the latter category including such things as horse riding and off-road vehicle use which are excluded from designated areas or banned altogether. Indeed, the concept of 'appropriate use' was enshrined in several pieces of Australian national park legislation which were drafted since the mid-1960s and agencies with related recreational interests, such as the Australian Water Resources Council (AWRC, 1985, 229-32), adapted the approach to their own views of what constituted appropriate use.

This approach is doomed to frustrating failure. Whatever its benefits in controlling conflicts between participants in different forms of recreation, controlling activities is a very blunt instrument for the management of environmental impact, largely because of variations in the *style* and associated impact of recreation activities (Bryan, 1977). For example, camping varies from a lone hiker to motorhomes: some styles of the activity may be appropriate, others may not. Impact also varies with the number and behaviour of participants, duration and the characteristics of environments (Turner, 1982).

The 'supply and demand' model took an early and firm grip on our approach to recreation planning and management and we were mesmerised by the need to measure and influence demand. The fact that we were invariably measuring *consumption* rather than the economists' concept of demand was not the greatest problem with this point of view. The assumption that demand is the driving factor in recreation management in protected areas is rarely true, especially in environments that have other values, such as water supply or wildlife refuges. Demand is important insofar as managers need to know what people expect from visits to an area. Meeting that demand, however, would probably result in a scale of environmental impact inconsistent with the idea of national parks being set aside to protect their natural and cultural values from modification by our technological culture. Demand should be seen as a qualitative, rather than quantitative, variable for natural area recreation managers.

Traditional recreational planning has been characterised by descriptive accounts of resources and equally descriptive accounts of what visitors have done. Neither have contributed much to our understanding of the future, nor have they provided criteria to guide or explain management intervention. It is not surprising that interest groups who perceive they are not adequately catered for have challenged the rights of planners to make value judgements about acceptable uses within national parks without the concomitant requirement to demonstrate the basis for such decisions. Accountability is an issue for natural area managers because the public - the owners of the resource - want to know what decisions managers have made on their behalf and why they were made. Guesses aren't good enough.

Natural area management planning in general, and recreation planning in particular, are comparatively new forms of 'environmental control' in Australia; they still have small information bases and attract little

research attention. This is true also of many other aspects of environmental public policy. The consequences have included:

- the value judgements of park managers, other institutionalised interests and various community groups have been spared rigorous review;
- public debate has been dominated by assertion rather than supported by facts; and
- systematic research-based approaches to natural area recreation management have been slow to develop.

Improving the accountability of the rational, data based component of planning requires an approach providing an explicit basis for decisions about acceptable recreation activity and facilities and exposing those decisions to assessment, review and modification in the light of new information and/or changing public values, management objectives or other circumstances.

Recreational use of water catchments

The increasing concern during the mid-1980s about the recreational use of water catchments throughout the Australian Alps of Victoria, New South Wales (NSW) and the Australian Capital Territory (ACT) provides an example of the way in which a rational basis for decisions about the recreational use of natural areas can contribute to management (Turner, 1988).

Approximately 80 per cent of Canberra's domestic water supply comes from three dams built on the Cotter River, with the balance coming from the Googong Reservoir on the Queanbeyan River in adjoining NSW. The Cotter has been managed as a closed catchment since the creation of the ACT during the first decade of this century. The water it supplies is of such high quality that chlorination, acidity correction and fluoridation was the only treatment most of it received in the mid-1980s (and the latter more recently has been the source of great community debate). However, in 1984 most of the catchment was included in the newly created Namadgi National Park.

The change in land use symbolised the debate between two philosophies of water quality management held in different parts of the ACT bureaucracy. The water supply engineers, managers of the dams and associated infrastructure, advocated a *non-degradation* strategy with an objective of ensuring that nothing was done which could lead to a decline in the quality of water leaving the catchment. The park managers, who managed the land in the catchment, sought to permit recreation and related uses within the limits set by the need to maintain *minimum standards* of water quality (cf. Hohenstein, 1987).

Similar issues were under discussion by about 1986 in the broader forum of the Australian Alps National Parks' Agreement (Memorandum of Understanding in Relation to the Co-operative Management of the Australian Alps' National Parks), an agreement between Commonwealth, ACT, NSW and Victorian ministers responsible for national parks to pursue co-operative management of the parks and related reserves in the Australian Alps (Davies, 1986; Garven, 1987; Good, 1987).

The situation is a common policy analysis problem of conflicting values being asserted without decision makers having available to them any information of the water quality impact of the recreational use of the catchment:

> *There has not been any co-ordinated monitoring program for the whole catchment to gather planning-oriented data. Unfortunately, the data available is (sic) often short of that required to rationally justify or reject particular strategies* (Cotter Catchment Water Supply Study Group, 1985, 54).

Having acknowledged the advantages of rationality in decision making and the place of data in informing rationality, the issue becomes one of measurement: what to measure and how to measure it. It is this issue which provides a specific objective of the search for a more analytical approach to recreation management planning and other forms of impact control in natural resource management.

Managing impacts on recreation settings

Natural resource managers usually can do more to influence the condition of the 'supply' than they can do to influence the amount, or type, of 'demand'. The central task of natural area managers should be balancing the benefits visitors derive from the places they are using with the costs of the impact of those visitors on those places and on each other. Recreation research's traditional preoccupation with descriptive accounts of participation and its correlates contributed little to a better understanding of how to achieve this balance.

Turner (1990) has identified six groups of criteria representing stages in the development of our understanding of what managers need to know about visitors to natural areas.

i) *aggregate demand:* research interest focused largely on estimating the economic benefits of the recreational use of parks and reserves

ii) *social aggregate variables:* interest shifted to describing the characteristics of visitors, initially concentrating on socio-economic status and life-cycle variables

iii) *social action variables:* the characteristics of visitors attracting research interest expanded to include attributes thought to influence their

individual and group behaviour, such as group membership and socialisation

iv) *psychological variables:* measures of beliefs and attitudes of visitors were included in an attempt to improve predictions of their behaviour (eg choice of activity)

v) *the linking of visitor and setting descriptions:* research began to focus on understanding the experiences visitors are seeking and the sorts of places for which they are looking

vi) *impact variables:* researchers have begun to search for the variables that can be measured to demonstrate the impact of recreation on the environment and the standards to assist judgements of what is unacceptable impact

This latter research (Manfredo et al. 1983; USDA Forest Service, 1985; Prosser and Paradice, 1987; Richards and Heywood, undated; Richards, 1992) represents a significant shift in recreation research away from descriptions of participation to a concern with *supply-oriented criteria* which are providing more useful measures of visitor benefits and environmental costs on which managers can base their approach to the management of use.

The most noticeable of these shifts has been the growing exploration of the linkages between the experiences people are seeking from their recreation, the activities they pursue and the characteristics of the places in which they prefer to undertake this activity. This has begun to provide managers with a much improved capacity to compare the benefits (experiences) visitors derive from use of natural areas with the costs (environmental impact) of that use and focused attention on supply rather than demand.

The Recreation Opportunity Spectrum (ROS) has provided a major stimulus to such understanding. The ROS is based on the recognition that recreation *activity* in *settings* produces *experiences* (Driver and Brown 1978; Clark and Stankey, 1979; Stankey, 1982). It is these experiences which are the goal of recreation behaviour. It became common practice during the 1980s for North American and Australian management agencies to describe recreation places in terms of their physical characteristics, such as size, access, facilities and so on, and attempts also were being made to describe social conditions, such as maximum party size and expected number of contacts per unit time (Table 11.1).

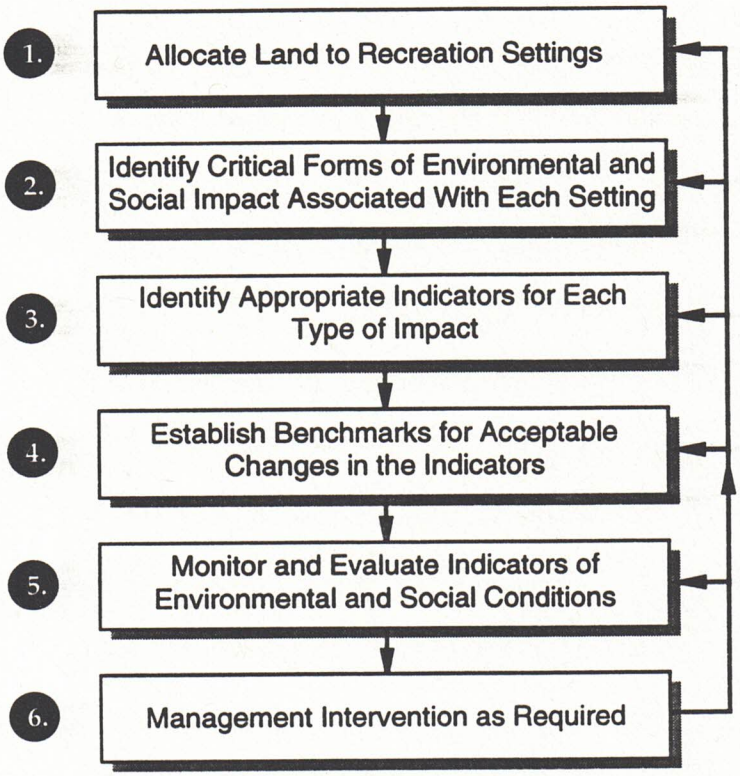
Identifying the key attributes of recreation settings in terms of environmental and social conditions provides the basic framework for assessing the impact of use on those key attributes. Any use of a setting will have some environmental and/or social impact: prevention of recreation impacts will require expensive and authoritarian management regimes and is not, therefore, a serious option in most circumstances. It will be useful, however, to distinguish between the concepts of *impact* and *damage*. Impact is a rational planning concept which can be measured in an objective manner without recourse to significant value judgements. Damage, on the other hand, acknowledges the important role of values and norms in making evaluative decisions. The distinction has at least two important benefits in nearly all natural resource management situations by identifying that:

Table 11.1 Recreation Opportunity Settings: A Classification for Natural Areas

Class 1. Remote Essentially unmodified environments of large size where interaction between users is very low and evidence of other users is minimal. Evidence of restrictions and controls are absent. Motorised access by the public is not permitted. The recreation emphasis is on self-reliance, independence, closeness to nature and tranquillity. Such areas offer a high degree of challenge and risk opportunities.
Class 2. Semi-remote Predominately natural or natural-looking environments of moderate to large size. Interaction between users is low, but there may be evidence of other users. Minimum on-site controls and restrictions are obvious. Limited vehicle tracks exist, for which access is permitted. High to moderate probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquillity and self-reliance. Such areas offer a moderate degree of challenge and risk and much of the parks are presently in this category.
Class 3. Roaded natural Natural-looking environments with moderate evidence of the sights and sounds of humans. Interaction between users may be low to moderate, but evidence of other users is prevalent. Opportunities for both motorised and non-motorised forms of recreation are available with a high degree of interaction with the natural environment. Overall, impressions of nature are not dominated by modifications and recreation facilities.
Class 4. Semi-developed Substantially modified natural environments. Sights and sounds of humans are readily evident, and interaction between users is often moderate to high. Includes facilities designed for use by large numbers of people and those provided for special activities.
Class 5. Developed Substantially urbanised environments, although the background may have natural looking elements. Vegetative cover is often exotic and usually heavily managed. Sights and sounds of humans are predominant and large numbers of users can be expected. Opportunities for competitive and spectator sports and for passive uses are common.

(Source: Department of Conservation, Forests and Lands, Victoria)

Figure 11.3 The Impact Management Process



- not all impact will be assessed as damage: some impacts will be acceptable to managers and/or users because they lead neither to ecosystem degradation nor to impairment of the quality of the recreation experience; and

- there is commonly a significant pattern of difference between the definition of damage by managers and by users (Manning, 1986, 36-7).

The Limits of Acceptable Change (LAC) approach has adapted the concept of carrying capacity from agricultural science to recreation planning as a framework for an *explicit* process for making decisions about how much of each form of impact can be tolerated before it becomes damage, requiring intervention by managers to protect the resource (Stankey, 1980; Stankey, et al. 1985).

The ROS and LAC planning principles have been developed into an 'impact management process' (Figure 11.3), offering a decision support system for recreation managers as well as planners. This process has some parallels with the use of environmental impact assessment (EIA) in other spheres of planning (Carley, 1980; Tomlinson, 1986). The two major developments, to which we will return when drawing some conclusions, are:

- the use of the approach in continuing program management rather than solely as a project approval technique; and
- an emphasis on the analytical, rather than advocacy, applications of EIA.

Impact management is an attempt to provide a logical and explicit process which aids communication between planners, managers and the public to replace the 'black box' of so much recreation planning. It demonstrates the *explicit* combination of managerial judgements with quantitative and qualitative measurements in a way which can frame decisions about the acceptability of environmental and social

impacts associated with the recreation use of natural areas. This will not remove conflicts among managers or users, and between managers and users, but it will contribute to clarifying what that conflict is about and, in that way, contribute to the identification of the place of values in the decision making process (Cullen, 1990).

The impact management process

The model classifies the process of managing impacts into six broad steps (Figure 11.3). The first deals with allocating land to settings, four steps categorise a rational process for measuring the condition of those settings, while the final step is management intervention to protect the settings from the unintended consequences of use. This model assumes that the key attributes of recreation settings have already been identified (e.g. Table 11.1).

The successful application of this model requires the identification of predeterminated levels of *acceptable change* for given indicators of recreation induced impacts. There are no formulae, or rules, for determining these levels of acceptable change. They require professional judgement from experienced resource managers, taking into account the important values to be maintained, the linkage between use and impact, the resilience of the particular ecosystem and the manager's judgement of how park users will perceive the various impacts.

Allocation

Allocating land to recreation settings (eg Table 11.1) is an iterative process. A preliminary allocation is necessary early in the planning process, but this initial judgement is only a guideline, to be modified in the light of further information on both impacts and on public expectations.

The historical usage patterns of an area are a starting point, and need to be considered in relation to opportunity settings beyond the planning area boundaries. It is not necessary to have all of the classes represented in Table 11.1 (or any similar classification) in any particular park and in many cases all of the facilities that might be provided in the most developed settings may be outside of a national park.

Public participation is desirable once these preliminary judgements have been made so the judgements can be tested against public concerns.

Identifying impacts

Most natural area managers are aware of the general types and amounts of use that are associated with particular recreation settings. They are used to identifying the impacts associated with those uses (Table 11.2) and to making judgements about when the impacts are unacceptable (Preston et al. 1986). It is necessary to document these professional judgements of experienced researchers and managers to assist others with less experience in making judgements about the identification and measurement of the relationship between use, impact and damage under various conditions. Furthermore, documentation is an essential step in making the basis of any decision explicit and available for critical review. Accountability - or at least the documenting of how and why decisions are made - should be a component of all good planning.

Table 11.2 Types of Impact and Potential Indicators: Australian Alps National Parks

Some Key Impacts	Potential Indicators
Sewage discharge	Total phosphorus Faecal coliforms Streptococci
Solid waste disposal	BOD in leachate Smoke Wind blown litter
Accelerated erosion	Gullying Turbidity
Compaction	Bare soil Exposed tree roots
Vegetation disturbance	Area disturbed Species change
Wildlife disturbance	Habitat impaired Changes in animal sightings
Noise	Decibels
Traffic congestion	Delay times
Litter	Visual assessment
Introduced plants and animals	Weed species Feral animal populations
Increased bush fire hazard	Proportion of bushfires caused by humans
Perceived crowding	Number of contacts Number of campsites Expressed (dis)satisfaction with visit

(Source: Cullen and Turner, 1987; Garven, 1987, 9-14)

Identifying indicators

It is necessary to identify appropriate variables that will be indicators of the various types of impact. These indicators must be both valid, in that they respond to changes in the environment brought about by the impact, and must be susceptible to reliable measurement by different operators. Managers need to select indicators that enable changes in vegetation, soil,

Table 11.3 Criteria for Selecting Environmental Indicators

Long term significance	Indicator must detect changes that occur slowly but consistently, and must be able to detect trends over a five year period.
Short term significance	Indicator must be able to detect changes in conditions which occur within any particular year.
Responsive	Indicator must detect changes early enough to enable a management response and must reflect changes that are subject to manipulation by management
Detects Amount	Indicator should be measurable and allow the amount of change to be assessed quantitatively.
Feasible	Indicator must be reliably measurable by field staff using simple techniques.
Economical	Indicator must produce meaningful information for managers at a minimum cost.

(Source: Cullen and Turner, 1987)

water or other relevant conditions to be detected before such change becomes catastrophic, by which time it is visible to all, and may be irreversible.

This is more complex than it first appears for there is little agreement as to what constitute useful indicators of recreation impact and it is necessary to develop indicators appropriate for particular locations and for particular issues (Merigliano and Krumpe, 1986). Some preliminary criteria suggested by Cullen and Turner (1987) for selecting environmental indicators in the Australian Alps' National Parks are summarised in Table 11.3 and indicators considered appropriate for the Alps are identified in Table 11.4.

Establishing acceptable change

The most significant technical constraint to using environmental and social indicators in the management of environmental impacts is identifying and measuring cause - effect relationships within naturally variable environmental conditions. A good indicator varies in response to real changes in the system: that is it indicates something! The problems include:

- finding indicators that are satisfactory reflections of the general condition of a recreation setting; and
- differentiating between changes which are due to recreation impact and changes which are just 'natural' variations in the indicator.

Few, if any, of the indicators identified in Table 11.4 are entirely stable, even in the most undisturbed situation. The challenge for researchers and managers is to differentiate significant trends that signal impending damage from the normal day to day, month to month and year to year variations due to weather and other uncontrollable factors.

The most appropriate response appears to lie in a two stage process of identifying a baseline or a base zone beyond which lies significant change (Stankey, 1980; Stankey et al. 1985). The base values for a given indicator are those which can be measured when no impacts have occurred. Managers are required to make judgements about reasonable base levels for each of the indicators. For example, it might be appropriate to consider zero as a base level for indicators like soil compaction, bare soil and so on, but for others, such as total phosphorus in stream waters (where there is a natural background level in waters draining pristine areas), 'normal' levels of the indicators will be above a zero base. The best way of establishing base levels is to measure the indicators in undisturbed 'reference' areas, or to make objective but explicit assumptions about what is reasonable given experience in other areas. It will be necessary to infer baseline conditions from knowledge of comparable, but less damaged, areas where conditions are already degraded to an unacceptable level.

Values for a particular indicator approaching or falling outside the base level provide a warning that managers should investigate the problem and possibly intervene to reduce the pressure if this is considered necessary. Some baselines suggested for the Australian Alps are summarised in Table 11.4.

It is necessary to assess the uncertainty of any prediction of how an ecosystem will react to changing any given variable (Mackay and Hillman, 1984). This uncertainty is partly due to our poor understanding of ecosystem processes, and partly due to the stochastic nature of critical driving factors such as rainfall (or its absence), fire conditions, pest infestations, and so on. The best way to handle such uncertainty is to plan on the basis that acceptable conditions will prevail for a certain proportion of the time. It is appropriate to say, for example, in the case of water quality, that phosphorus levels downstream of a ski village should be less than 40mg per cubic metre for 95 per cent of the time, rather than produce a blanket limit which will not be achievable under extreme runoff events upstream or downstream of the ski village. This approach might be helpful in dealing with indicators for other impacts.

Table 11.4 Possible Levels for Selected Indicators of Impacts

INDICATOR	PROPOSED BASE LEVEL	UPPER ACCEPTABLE LEVEL
Receiving Water Indicators		
Total Phosphorus	<20mg/L	Exceed 40mg/L<5%time
Faecal coliforms/streptococci	<??	
Turbidity		
Conductivity		
BOD in leachate from tips	<5mg/L	<5mg/L
Land Indicators		
Bare areas of soil around campsites	<1%	<2%
Exposed tree roots	none	<1m total near camps
Gullying	?	
Compaction- penetrometer		
Area disturbed	none	
Species changes	none	none
Habitat impaired	none	
Weed species observed	?	
Human ignited fire	?	?
Sensory Indicators		
Decibels	0	?
Visual assessment	subjective	
Wind blown litter	none	none
Smoke	very occasional	
Social Indicators		
Crowding -	?	?
number of encounters		
attitude to encounters		
Inter-group conflicts	complaints from x% of users?	

(Source: Cullen and Turner, 1987)

Decision makers faced with value judgements of this kind have to consider whose judgements are to be used in making the decision. Hence the place of public participation in making judgements about how much environmental change is regarded as acceptable requires further examination (Turner, 1979;1981).

The place of social impact in this planning approach has yet to be addressed in the same detail. Social impacts are certainly important in determining the quality of recreation experience, particularly in remote areas where the measurable levels of environmental impact are likely to be low, intermittent and difficult to measure. Social impacts may be more important limitations than environmental impacts in these cases. There is considerable scope for further research into the identification and measurement of social impacts and how such data can be incorporated into management strategies.

Monitoring and evaluating indicators

Recreation and natural area management are not alone in suffering the information flood or famine which arise from data driven planning. Monitoring programs of all kinds frequently generate a vast amount of data which are not, or cannot, be used in planning, while data which could be used to solve planning and/or management problems are unavailable (cf. Cotter Catchment Water Supply Study Group, 1985; TRRU, 1981).

There are at least three reasons for this widespread problem:

- the lack of a clearly understood relationship between the technical procedure of collecting data (monitoring) and the evaluative process of providing problem solving information to decision makers (evaluation);
- the frequent failure to set management-related objectives for monitoring programs (ie lapsing into data driven rather than problem driven planning); and
- the technical complexities inherent in measuring recreation behaviour and environmental conditions.

The wide variety of circumstances under which monitoring and evaluation might be conducted, and the problem-specific nature of individual programs which could be generated, preclude any attempt to prescribe detailed solutions to these problems. It is useful, nevertheless, to identify some general principles.

Monitoring and evaluation are linked as a related step in the impact management process (Figure 11.3). This link between problem solving and data collection is essential for escaping 'ad hocracy' and/or the information overload which comes with collecting data without a clear idea of the purpose to which it is to be put, as well as the increasingly difficult task of justifying public expenditure on collecting data that may never become useful information for decision makers.

The details of a monitoring program are largely determined by its purpose, which could be one or more of the following:

- identifying changes in levels, or types, of use;
- identifying long term trends in resource conditions;
- identifying environmental response to stress;
- assessing compliance with management plans; and
- assessing effectiveness of management activities.

There are significant benefits for rational decision making in identifying which objectives are driving the collection and interpretation of data.

Even when objectives have been specified with great care there are several difficult technical decisions to be taken with regard to the collection of data. These include:

- Selecting indicators

  The problems of identifying valid indicators have been discussed already.

- Frequency of sampling

  On what time basis should sampling be undertaken? Should it be on a calendar basis, on the basis of stress on the resource, on variations in external factors such as changes in accessibility, or the availability of sampling resources? The appropriate response will depend on the indicator and on the likely temporal basis for it changing.

- Spatial distribution of sampling

  What is the best number and location of sampling stations? The minimal amount of data needed to meet objectives needs to be assessed before considering problems of access and costs of data collection. Must the sampling stations be randomised for the statistical analysis envisaged?

- Sampling and replication

  How many replicate samples are necessary to achieve the necessary precision and accuracy? How much uncertainty is tolerable?

- Analysis and evaluation of data

  How will data be stored, manipulated and used to provide reports and management information?

Changes in technologies of measurement, particularly the use of remote sensing data and automatic recording devices, mean it is essential to be clear as to what measures are needed so that appropriate levels of precision and accuracy can be determined. The problems of access and operator skill also need to be considered in designing monitoring programs: 'high tech' solutions will not be of much assistance if they are too expensive or too complex to be used in field situations.

Conclusions

Recreation and other forms of natural resource (eg water) management can be based on a problem driven, data based approach to rational decision making. The development of research instruments for the measurement of both recreation benefits and environmental/ social impact promises to provide a framework for the application of 'environmental cost benefit analysis' to the rational aspects of planning and management. Natural areas are a major community asset which can be both protected for their ecological and aesthetic values and used to produce recreation experiences for visitors. Planning and management decision makers can weigh the benefits of recreation experiences and costs of environmental and social impacts of combinations of these conservation and utilisation objectives in alternative strategies when both benefits and costs can be measured. Here is a rich vein for recreation research and planning in Australia which promises to yield a more valuable product than yet more descriptive studies of visitor behaviour.

Recreation planning in natural areas cannot continue to be driven by descriptive accounts of demand if the resource is to be maintained. The concerns about recreation most frequently expressed by conservation groups and park managers relate to the damage that might be done to natural and cultural resources by excessive recreation pressures. Managers need to focus on the measurement of types and amounts of impacts generated by different forms of recreation so that they can identify the recreational use a given location can tolerate without unacceptable impact.

Impact management provides an explicit framework to assist communication between managers and community interests about the conditions they would like to see attained or maintained for conservation and recreation. It identifies not only when management intervention is required, but also what the

consequences of that intervention might be for users in terms of opportunity and financial costs.

The present impact assessment process model incorporates only objective measures of impact and subjective evaluations of the acceptability of that impact. The approach warrants further development to assess its capacity for handling other information based components (both facts and values) of environmental planning and management. The solid theoretical basis provided by the ROS and LAC and the beguiling simplicity of the impact management process model mask two complex problems facing the development and practical application of the model:

- *technically*, is it possible to identify and collect the data needed to provide a rational basis for management intervention? and
- *politically*, will managers and the public find the value judgements and their consequences inherent in the assessment of damage any easier to live with than the value judgements in assessments of acceptable use?

Some ingenuity will be required to satisfy the technical (data availability) and political (value acceptability) assumptions on which the widespread application of this process rests. However, such ingenuity could generate benefits in a range of impact assessment approaches to natural resource planning and management, thereby offering some new and much needed credibility for impact assessment as an analytical technique.

There are at least two reasons contributing to the jaundiced view of environmental impact assessment in Australia. The first is that the use of impact assessment in the planning process is seen to be restricted to 'threshold' decisions about the approval or rejection of particular development proposals. There appears to have been little success in incorporating the concepts of predicting environmental or social impact into strategies for managing the impacts, which continue after the development stage has been completed and which accumulate with each new development. Second, and perhaps because of the former, environmental and social impact statements are seen to be advocacy documents prepared on behalf of a development, rather than as analytical attempts to predict the impacts of a development as a basis for a review of its acceptability to a variety of interests. These shortcomings are widely recognised and environmental impact assessment processes are under close scrutiny by all the interested parties throughout Australia and overseas (Tomlinson, 1986; Buckley, 1989; Australian and New Zealand Environment and Conservation Council, 1991).

The logic of the impact management process suggests that it is possible to develop an explicit and accountable process for keeping environmental and social impacts arising from use of the environment within acceptable levels and that, as a consequence, impact statements could fulfil a more useful analytical role in controlling environmental change. These conclusions indicate something of the link between rational (technocratic) and conflict management models of decision making which also warrants further study by those interested in understanding the contribution of 'facts' and 'values' to environmental management.

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