

Abstract

National parks and conservation reserves are subject to increasing levels of recreation and tourist pressure. These produce environmental impacts associated with travel, accommodation and recreational activities. Typical impacts in Australian parks and reserves include soil erosion and compaction, damage to vegetation, disturbance to wildlife, water pollution, increased fire frequency, vandalism and noise. To minimise the environmental degradation associated with tourism and recreation may require appropriate land use zoning; regulation and surveillance of access and activities; direct physical protection of particular areas; and education both on-site and elsewhere. In addition, it is important to provide incentives to encourage low-impact types of recreation, such as contemplative, naturalist and wilderness travel activities; and discourage high-impact types such as sporting and social activities, use of motorised vehicles, and accommodation involving building and engineering construction.

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Environmental Impacts of Tourism and Recreation in National Parks and Conservation Reserves

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Tourism is now a major international industry. One sector of the industry which is growing particularly fast is tourism and recreation in natural areas, where the tourist attraction is provided by relatively undisturbed natural environments. National Parks and conservation reserves are subject to increasing levels of tourism and recreation, firstly because recreation in natural areas is becoming even more popular, and secondly because real funding for the management and maintenance of conservation reserves has fallen so that reserve managers have been forced to seek alternative sources of funds.

Good environmental planning and management is particularly crucial in natural-areas tourism because environmental impacts are not external to the industry, as they are in the case of most primary production and secondary manufacturing industries; but internal and indeed central to the economic base of the industry itself. If well planned and managed, natural-areas tourism is potentially an industry with extremely low environmental impact, and high and indefinitely sustainable economic return. If poorly planned and run, however, the reverse will be true: high environmental impact, low and short-term economic return.

Whilst individual corporations can certainly extract large profits from short-term non-sustainable tourist development in natural areas, such an approach will rapidly destroy the resource base for the Australian tourist industry as a whole, to say nothing of its impacts on domestic recreation and on cultural and environmental heritage.

Management of tourism and recreation in natural areas must consider three main issues, as follows:

- zoning: which areas should be used solely for tourism, which for tourism and other uses contemporaneously, and which solely for conservation and other uses?
- intensity of use: how many people, engaged in what activities, can be accommodated in a given area without environmental degradation?
- multiple-use management: how can reserve areas be managed so as to generate a net economic return from tourism and recreation without compromising

recreation. This would include, for example, state forests, coastal reserves, Crown lands etc. In practice, however, information is only available for national parks and conservation reserves and not for all of these. The patterns reported here are hence derived principally from management plans for parks and reserves and from the relatively few academic studies in particular areas.

Impacts on the natural environment

Impacts on the natural environment may usefully be considered in three main categories: those associated with transport and travel; those associated with accommodation and shelter; and those associated with recreational activities *per se*. Major impacts on the physical and biological environment in each of these categories are summarised in Tables 1-3; and those impacts which have actually been recorded in Australian national parks are summarised in Table 4.

In addition to these primary impacts, a wide range of secondary impacts can also occur. As one common example, many conservation areas are traversed by tracks, which may provide service access for fire fighting, garbage removal, provision of firewood etc. or which may predate the declaration of the reserve. These tracks, even if not formally open to the public, provide access to vehicles and people. Such uncontrolled access is particularly significant in large remote areas which typically have too few rangers for adequate surveillance. Continued use of these tracks by vehicles causes soil erosion and compaction, prevents the regrowth of vegetation, introduces weeds and fungal pathogens, and increases fire risks. In some cases, erosion as a result of uncontrolled vehicle access may eventually render the tracks impassable for service vehicles, so that, for example, the tracks are no longer serviceable for fire fighting.

Besides the direct impacts of vehicles, people using these tracks may light fires, intentionally or unintentionally; shoot wildlife; damage vegetation at casual campsites; and collect firewood; which in turn can lead to a decline in

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their primary use for conservation?

Planning in any of these areas needs information on the relationship between the numbers, activities and behaviour of visitors, and the environmental impacts they produce; questions of response sensitivity and thresholds. The most reliable way to obtain such information is to examine what impacts have actually occurred in the past. Previous reviews by El-Hinnawi and Hashmi (1982), Holdgate *et al* (1982) and Duffield and Walker (1984) identified broad areas of potential concern but found few specific examples to report. Tourism has still not received a great deal of attention from academic ecologists, but a substantial body of information is now available from scientists and managers responsible for parks and reserve areas.

Our initial intention was to review the impacts of tourism and recreation on all natural areas in Australia, whether or not these areas were formally classified as conservation reserves and whether or not their principal use was for either conservation or tourism and

Table 1: Environmental impacts of transport and travel

Means of transport/travel	Vegetation clearance or damage ¹	Soil erosion or compaction ¹	Wildlife disturbance, shooting or habitat destruction ²	Solid wastes	Water pollution ⁷	Air pollution	Noise ⁸	Increased Fire Risk	Weeds and Fungi ⁹
Light planes, helicopters	Airstrips only	Airstrips only	Depends on speed, altitude, frequency of flights	Empty fuel drums at remote strips	—	—	Loud, but intermittent	Little or none	Airstrips only
Bus or car on road	Roads and verges cleared	Compaction and erosion on unsealed roads	Noise depends on traffic density; roads can act as barriers; road kills	Litter	Petroleum residues in run off from roads	Exhaust fumes	Line source, volume depends on traffic density	Sparks, cigarette butts	Along road verges
Car or 4WD on tracks	Tracks cleared; tend to be widened and new tracks cut	Dust, gully erosion and compaction widespread	Road kills, noise, shooting	Litter	Turbid runoff	Exhaust fumes	As above	Sparks, cigarette butts	Along track verges
ORV's off track ²	Severe and extensive vegetation damage	Erosion widespread, depends on terrain and soil type	Widespread noise disturbance; ORV's used for shooting	Litter, human wastes	Campsites only: bacteria, soap	Exhaust fumes	Major impact, since ORV's can enter otherwise quiet areas	Sparks, butts, campfires	Spread on tyres
Mountain bikes	Less severe than ORV's	Localised in heavy use areas	Disturbance in heavy use areas	Litter, human wastes	Campsites only: bacteria, soap	None	Voices only	Butts, campfires	Spread on tyres
Horses ³	Trampling on horse trails	Localised, trails and holding paddocks	Minimal, unless riders rowdy or shooters	Horse manure	Nutrients, bacteria, downstream of holding paddocks	None unless very crowded	Voices only	Butts, campfires	Spread in fodder if carried
Hiking ⁴	Trampling on heavily used trails	Localised on heavily used	Generally minimal	Human wastes	Campsites only: bacteria, soap	None	Voices only	Butts, campfires	Minimal, on boots and socks
Power boats ⁵	Campsites, shoreline and aquatic vegetation	Not applicable	Noise, fishing and shooting	Garbage at campsites, jetsam	Fuel residues, nutrients, bacteria, antifouling paints	Exhaust fumes	Engine noise	Campsites only	Campsites only
Unpowered watercraft	Generally none	Not applicable	Fishing only	Garbage and jetsam	Bacteria, soap	None	Voices only	Campsites only	Campsites only

1-8: See references listed below; additional observations by RB.

Table 2: Environmental impacts of accommodation and shelter

Type of accommodation or shelter	Vegetation clearance or damage	Soil erosion and/or compaction ¹	Wildlife disturbance or habitat destruction ²	Firewood collection and campfires ¹⁰	Solid wastes ¹²	Water pollution	Noise ⁸	Visual ¹³
Resorts, Hotels Construction	Site clearance	Short term, during construction	Habitat cleared, noise		Construction rubbish, builders rubble	Sediments	Construction plant	Construction site and plant
Continuing	Tracks etc	Unsealed tracks etc	Shyer species leave area	Collected elsewhere if used	Garbage treated sewage	Sullage, increased nutrients	Machinery and motors	Conspicuous buildings and infrastructure; large vehicles
Fixed car or caravan camps ¹¹	Site clearance initially and continuing, tracks etc	If ungrassed and increasing with use	Habitat clearance, shyer species leave area	Large area often denuded	Garbage, litter, toilets	Sullage, increased nutrients, bacterial	Generators car engines, chainsaws, radios, voices	Vehicles, caravans, large tents, equipment, campfires
Overnight car/4WD camps ¹¹	Increasing with use	Increasing with use	Depends on frequency of use	Large campfires common	Litter, human wastes	Bacterial, soap	Car engines, chainsaws, radios, voices	Cars, large tents, campfires
Horse/Hiker huts	Local site clearance, trampling	Localised, depends on soil type etc	Minor, localised	Large area often affected, regular large campfires	Litter, horse dung, human wastes	Bacterial	Saws, voices	Huts, cleared paddocks, campfires
Boat access shore sites	Increasing with use	Bank erosion	Minor, localised	Large area often affected, regular large campfires	Litter, fish guts, human wastes	Petroleum residues	Outboard motors, voices	Boats, large tents, fires, clearance
Often used bush camps ¹¹	Localised, new tent sites	Localised, depends on soil type etc	Minor, localised	Depends on vegetation type: large area may be affected	Some paper, human wastes	Bacterial, soap	Voices	Small tents, fires
Single-use camps & bivouacs	Minimal or none	Generally none	Temporary or none	Minimal or none	Generally none	Generally none	Minimal or none	Minimal and temporary

1-13: See references listed below; additional observations by RB.

Footnotes, Tables 1 and 2

(1) Ovington *et al* 1973; Little 1975; Edwards 1977, Keane *et al* 1979, Inghram 1980, Calais 1981, Calais 1982, Pitts 1982, Uptis 1982, Mackay 1983, Gibson 1984, Chape and Chalmers 1984, Ringewaldt 1984, Brandis and Battini 1985, Cook 1985, Bayly-Stark 1985, Kuss 1986, Neyland 1986, Little and Thyer 1986, Calais and Kirkpatrick 1986, O'Loughlin 1988, Brown 1988, Gillen 1989, Snelson undated, Gillieson *et al* undated. (2) Alexander 1981, Kay 1981, Pech and Graetz

1982, SANPWS 1984, SADEP 1984, TDLPW 1988, Brown 1988. (3) Snelson undated. (4) Helgath 1975, Leonard and Plumley 1979, Kay and Liddle 1984, SANPWS 1984, NSWNPWS 1985, ANPWS 1986a (5) SADEP 1984, Cook 1985, Bayly-Stark 1985, ANPWS 1986b, Nicholls 1988. (6) Busack and Bury 1974, Barnett *et al* 1978. (7) Pitts 1982, O'Loughlin 1988, TDLPW 1988, Brown 1988, Barnett 1989, Gillen 1989, Snelson undated, Peerless undated. (8) SANPWS 1984,

VNPWS 1987, Williams *et al* 1988, Gillen 1989, Peerless undated, Snelson undated. (9) Brandis and Battini 1985, Neyland 1986. (10) Lewis 1978, SANPWS 1983, 1984, NSWNPWS 1985, Huxtable 1987, VNPWS 1987, TDLPW 1988, Gillen 1989. (11) Leeson 1979, Cole 1981, Pitts 1982, SANPWS 1986, Brown 1988, O'Loughlin 1988. (12) NSWNPWS 1985, Brown 1988, TDLPW 1988, Gillen 1989. (13) ANPWS 1986a, Williams *et al* 1988.

vegetation productivity and soil nutrient status, changes in the vegetation both as a floristic assemblage and as fauna habitat, and damage to plants both directly and by increased susceptibility to pests and pathogens (Huxtable, 1987).

Secondary impacts can also arise from attempts to mitigate primary impacts. For example, heavily used walking trails commonly suffer erosion and down-cutting. They are then widened into multiple trails as pedestrians avoid the eroded areas. To prevent further erosion, managers may "harden" the track by installing paving, duckboarding, or similar made paths. In addition to the visual impacts of such paths on visitor experience, track construction may also produce additional impacts on the natural environment. As an example, a heavily used walking track from Charlotte's Pass to Blue Lake in Kosciusko National Park was recently paved and gravelled. Besides forming a conspicuous and intrusive visual scar, the track is now flanked by introduced weeds. Presumably, those responsible for providing the gravel had omitted to sterilise it, so that it still contained weed seeds; and the disturbance to the track margins provided a suitable habitat and opportunity for

Table 3: Environmental impacts of recreational activities in natural areas

Type of activity	Accommodation or shelter	Travel & transport in recreation area	Additional impacts
Principally sporting "excitement" activities			
downhill skiing	resorts or lodges	skis	ski lifts
kayaking	tents	kayaks	—
sailing	yachts	yachts	—
biking	tents or lodges	cars, bikes	—
climbing	tents or huts	cars, feet	—
caving	caves or camps	cars, feet	cave fauna
hunting (game)	hotels or huts	ORV's or feet	loss of wildlife
shooting (birds)	hotels or camps	cars, boats	loss of wildlife
ORV's	hotels or camps	ORV's	
Principally naturalist "contemplation" activities			
resort stays	resorts, hotels	cars, coaches	ill-informed sightseers;
plane safaris	resorts, hotels	planes	vandalism to
coach tours	resorts, hotels	coaches	archaeological,
4WD safaris	tents, camps	4WD vehicles	cultural and
horse safaris	tents	horses	natural heritage
canoe safaris	tents or huts	canoes	areas
ski touring	tents or huts	skis	
bushwalking	tents or huts	feet	
birdwatching etc	various	feet	
fishing	various	boats, powered or otherwise	

these seeds to germinate and establish. The secondary impact, namely introduction of weeds, is arguably much more severe than the primary impact, namely down-cutting of pedestrian tracks. As another example, Hamilton-Smith (1987) reported that a moisture proof door installed at Alexandra Cave, Naracoorte, to minimise damage to the cave walls and paintings, caused local extinction of the relatively uncommon cave weta.

The precise impacts of different types of travel and recreational activity also depend on local environmental parameters such as aspect, steepness, soil type and vegetation. Trampling causes more erosion on some soils than others, for example. Human wastes are more likely to create problems in areas with thin soils; and pollution from human wastes is more likely to be significant in highly oligotrophic waters such as those of

Table 4: Environmental impacts identified in Australian National Parks

SIGNIFICANT ENVIRONMENTAL PROBLEMS ASSOCIATED WITH TOURISM AND RECREATION																	
National Park	Tracks and ORV's	Trampling (human or horse)	Weeds and fungi	Boats damage bank	Firewood collection	Human wastes	Camp sites	Water pollution	Changed water course	Water depletion	Disturbance to wildlife	Damage to archaeological sites	"Cultural vandalism"	Litter	Visual impacts: roads and buildings	Noise	Reference
Western Australia Cape Range Stirling Ranges	•	•			•					•					•		Peerless n.d. Brandis & Batini 1985
Northern Territory Kakadu Uluru	•	•		•					•			•	•	•	•	•	ANPWS 1986b Ovington <i>et al</i> 1973. ANPWS 86a
South Australia Simpson Coongie Flinders Coorong	•••	•	•		•		•	•		•	•	•	•	•••	•	•	SANPWS 1984 Gillen 1988 Williams <i>et al</i> 1988 SADEP 1984
Queensland Carnarvon						•		•				•	•				Pitts 1982
New South Wales Mount Warning Kanangra Boyd Blue Mountains Kuring-gai Kosciusko	•	•			•	•	•	•••	•				•	•	•	•	NSWNPWS 1985 Brown 1988 Brown 1988 Snelson n.d.
Victoria Croajingolong Wilson's Promontory	•	•			•	•				•				•	•	•	VNPWS 1985 VNPWS 1987
Tasmania Cradle Mt. St. Clair Gordon River Southwest		•		•	•	•		•						•			O'Loughlin 1988 TDLPW 1985 Cook 1985, Bayly-Stark 1985 Neyland 1986

• = recorded in reference cited = observed by RB.

montane or sandy freshwater streams.

Besides impacts on the biological and physical environment, recreational activities may also produce detrimental impacts on the human environment. Such impacts fall in three main categories. The first includes damage to archaeological sites and materials such as cave walls, rock art and carvings (Pitts, 1982; ANPWS, 1986a; Kiernan, 1987; Gale and Jacobs, 1987); disturbance to aboriginal middens (Gillen, 1989); and souveniring and vandalism (Gale and Jacobs, 1987; Gillen, 1989). The second major category of impacts is cultural rules, e.g. by trespassing on sites or photograph-

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ing paintings of special significance, or engaging in culturally offensive behaviour of various types (Pitts, 1982; ANPWS, 1986a; Gale and Jacobs, 1987; Gale *et al* 1988; Gillen, 1989; Snelson, undated). Such impacts may be deliberate, or more often, occur through ignorance. The third category is of impacts on local residents, generally through heavy use of infrastructure.

Impacts on visitor experience

Surveys of visitors to natural areas show that they expect and want such areas to have little or no development (Downing and Clarke, 1979; SANPWS, 1983; TDLPW, 1988). Visual impacts, noise and crowding are common sources of complaint, and environmental damage even more so (Frissel and Duncan, 1965; Stankey, 1973; Badger, 1975; Lee, 1975; Lucas, 1979; Clarke and Stankey, 1979; Vaske *et al* 1982; NSW NPWS, 1985; ANPWS, 1986a; VNPWS, 1987). Many of these complaints reflect conflicts between different groups of visitors, notably the asymmetrical conflicts between those who use mechanised means of transport and

those who do not (Lucas, 1964; Jacob and Schreyer, 1980; Adelman, *et al*, 1982; Dellora, *et al*, 1984). These concerns, however, are often disguised by recreational succession (Ovington *et al*, 1973; Pitts, 1982; Prosser, 1986; VNPWS, 1987); as the number and density of visitors at a particular site increases, and the characteristics of that area change in consequence, the type of people visiting the area, and their expectations, enjoyment and requirements, change over time. Those who have come to area to enjoy wilderness pursuits based on the enjoyment of undisturbed natural environments are replaced by those who have come to enjoy sports or outdoor social activities. Visitor surveys may thus still indicate that visitors to the area are content with current conditions; but they are not the same visitors. Those who visited the area in its earlier, more pristine state, dissatisfied with changing conditions, simply no longer go there. This makes it extremely difficult to monitor deterioration in the quality of visitor experience in any given area.

Management

Requirements for improving management of tourism and recreation in national parks and conservation reserves fall into two main categories: information and action. The first requirement is baseline information and resource inventory, not only in the reserve areas themselves, but for other natural areas within the region or country as a whole. This is necessary to assess the significance of potential environmental degradation within particular areas. The second requirement is to monitor environmental change, both that due to natural causes such as fires and rainfall variations, and that due to anthropogenic factors such as visitor pressure, feral animals and weeds, and land use in neighbouring areas. Linked with such monitoring of environmental changes, we need to monitor the numbers, types and behaviours of visitors to different parts of each reserve area, taking account of seasonal variations. From these types of information, reserve managers can identify specific management problems and issues which require action.

Management action can be considered in four main categories: regulation and surveillance, incentives, protection and education. Different types and levels of regulation are required at different scales in space and time. At national and regional scales, this approach can involve overall land use planning for conservation, tourism and recreation, and other land uses. At the scale of individual reserves for natural areas, it can include tools such as general guidelines for tourist development in natural areas, and zoning for different uses in different parts of a reserve areas. In the case of zoning, it is important to ensure that activities in one zone do not impinge on the planned functions of

important to avoid any form of development which encourages non-wilderness recreation. Facilities for non-wilderness recreation and sports, such as tennis courts, barbecues, golf courses, trail bike areas and ski lifts, should be placed outside wilderness areas.

Where high visitor numbers are perceived as desirable or inevitable, one management option is to protect or harden the areas concerned so as to minimise the impacts produced. Common examples might include paving of roads and tracks, installation of duckboarding along heavily used pedestrian routes and walking tracks, and provision of firewood, fireplaces and toilet facilities at heavily used campsites. Such hard-

reserves. The expert knowledge of reserve managers, gained through experience with the reserves concerned over a substantial period of time, would perhaps remedy this deficiency. It would not be easy to compile, however, and it is unlikely to be quantitative.

Since the demand for natural-areas recreation and tourism is increasing, and the supply of natural areas is not, it is realistic to assume that levels of tourism and recreation in parks and reserves will continue to increase in the immediate future. Informed management to minimise the impacts of such tourist pressure is therefore particularly important; and this requires information on the relationship between visitor numbers and activities, and their impacts on particular types of environment. Research in this field will therefore be critical to the successful management of our parks and reserves.

To minimise environmental impact a combination of planning, regulation, incentives, physical hardening and education . . .

another. As a common example, tourist development and recreation in the upstream part of a catchment may adversely affect water quality in the downstream region; so if the latter has been zoned purely for conservation, it may suffer water quality deterioration even though there are no recreational activities in the conservation zone itself. Regulations can also be used to control the numbers of visitors entering a particular area in any given time period, their access points, and the types of activities they may undertake. To ensure that such regulations are actually effective, however, requires some form of deterrent if they are breached, such as a fine or other penalty; it also requires surveillance to detect such breaches. Surveillance – typically by rangers – requires time, personnel and resources which can eat heavily into the reserve manager's limited budget.

The activities of visitors, and the resulting impacts on the natural and human environment, can often be controlled more effectively by incentive systems than by regulation. As one very obvious example, if a given area is intended for conservation and low-impact wilderness recreation, then it is

ening, however, tends to accelerate recreational succession.

The fourth major management option is education (Geist, 1979; Busher, 1979; O'Loughlin, 1988). In wilderness areas this may be the only option; and it can be very effective (O'Loughlin, 1988). Often the public does not appreciate what environmental impacts it may be causing in conservation areas (Huxtable, 1987). In general, visitors to conservation areas react positively to the provision of on-site information, modifying their behaviour to reduce environmental impacts (Gale *et al*, 1988); though there will always be exceptions. There are many different avenues for environmental policies: by individual tourist corporations and the tourist industry as a whole; displays at local community centres; and the introduction of environmental education in school and university curricula.

Discussion and conclusions

There is very little published information on the environmental impacts of natural-areas tourism and recreation, even in designated national parks and conservation

Meanwhile, some general principles may be stated as follows. Multiple-use management in parks and reserves should be restricted to uses which do not compromise the primary objective of conservation. Use of reserve areas as water catchments is one possibility, as long as dams and other storage systems are downstream of the reserve area. Some types of tourism and recreation are also acceptable, but others are not; and those which are, need to be confined to particular zones intended for conservation *per se*. To minimise environmental impacts of tourism and recreation requires a combination of planning and regulation, incentives to encourage particular activities and discourage others, physical hardening of areas receiving highest visitor pressure, and education both on-site and elsewhere. The question of incentives is of particular concern in a number of current tourist development proposals. Parks and reserves are suitable only for low impact recreation, such as those based on wilderness travel and natural history tours, etc. High-impact recreation such as sporting and social activities, the use of motorised vehicles and large-scale engineering and building construction should be discouraged in parks and reserves. It is thus inappropriate for tourist

developments in park and reserve areas to include facilities such as large hotels, conspicuous cable cars and ski-lifts, tennis courts and golf courses, or marinas or water ski areas.

It should be necessary to argue these points in relation to every tourist development proposal in park and reserve areas. Generic guidelines for natural-areas tourist development, adopted and adhered to by Commonwealth and State governments, and promulgated to all local government authorities, could overcome problems associated with the current piecemeal and *ad hoc* approach to natural-areas tourist development in Australia.

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