Biophysical Impacts of Tourism:
An Annotated Bibliography

Kirsten Crawford
Student, Environmental Management and Design Division,
Lincoln University.
crawfok1/Lincoln.ac.nz

Jeremy Phillips
Student, Environmental Management and Design Division,
Lincoln University.
Phillij1/Lincoln.ac.nz

Jonet Ward
Senior Lecturer, Environmental Management and Design Division,
Lincoln University.
Wardj@lincoln.ac.nz

Ken Hughey
Senior Lecturer, Environmental Management and Design Division,
Lincoln University.
Hugheyk@lincoln.ac.nz

May 2001

ISSN 1175-5385

Tourism Recreation Research and Education Centre (TREC)
Report No. 41/2001

Contents

Environmental Management & Design Division

and

Tourism Recreation Research & Education Centre

Lincoln University Canterbury 2001

Research Summary

This annotated bibliography focuses on the biophysical impacts of tourism. Literature was sourced from scientific, managerial and industry publications. Annotations include a description of the activities, biophysical impacts and indicators for assessing the effects of tourism. The publication has been developed in conjunction with the electronic database, *Indicators of Tourism's Biophysical Impacts* (www.lincoln.ac.nz/trrec/projects/envind/envirlitlit.htm).

Acknowledgements

We thank staff from Beca Carter Hollings and Ferner Limited for their early inputs into the preparation of this report. This report was funded under FRST Tender LINX0007.

Chapter 1
Introduction

1.1 Introduction

The impact of tourist activities on the biophysical environment generally increases as the intensity of use and development grows. In New Zealand, the tourism sector has consistently experienced significant levels of growth since the 1970's—a pattern that is set to continue with predictions of a 6.7% increase in international arrivals from 2000-2006[1]. At this rate arrivals will surpass 2.5 million by 2006[1]. This figure does not account for the large number of domestic tourists travelling throughout New Zealand. Faced with these projections it is necessary to identify the possible implications of this growth on New Zealand's wildlife, vegetation and physical environment and the resulting management requirements.

This annotated bibliography and literature evaluation aims to identify these implications by compiling a diverse range of literature on the biophysical impacts of tourism and recreation and subsequently establishing a comprehensive list of possible tourist activities, impacts and indicators of environmental change.

The criteria for including papers in this bibliography were that they:

1. Discussed the interaction(s) between tourist or recreational activities and the surrounding wildlife, vegetation and/or physical environment.

2. Were applicable to a New Zealand context (including Sub-Antarctic Islands).

Selected papers were then reviewed and information was extracted on six key areas: main focus of the research; natural asset and classification; tourism activity; environmental impacts and indicators for these. Much of the available literature was only partially concerned with the biophysical impacts of tourism, and the annotations included in this bibliography are concerned only with these interactions, they are not comprehensive abstracts.

As this bibliography is focused on biophysical impacts, the social or cultural effects of tourism (e.g. user perceptions and satisfaction, relationship to heritage and cultural sites) have not been included. Similarly, the research is focussed primarily on non-urban, attraction-based settings, therefore only limited work has been included on the impacts of tourist development, construction, transport and other services.

As with any bibliography, this document will be partially out of date before it is published. However, it will serve as a valuable reference guide for managers, academics and students interested in the impacts of tourist and recreational activities. To improve the accessibility and currency of this bibliography an

[1] Vuletich, S. and Fairgray D. 2000. *International Tourism Forecasts To New Zealand: 2000-2006.* McDermott Fairgray

online version is available at www.lincoln.ac.nz/trrec/projects/envirlit.html. At this site, users are able to search for information under a number of categories and through a key-word search. Additional information and publications relevant to the bibliography will be graciously received and visitors to the web-site are encouraged to submit details of studies online for inclusion in the database.

This bibliography and evaluation of the literature forms a small component of a larger study funded by Foundation for Research Science and Technology (FRST) that seeks to develop indicators of acceptable environmental change and management guidelines for tourist attractions around New Zealand. Other areas of research include the social dimensions of tourism, tourist flows and dispersal throughout the country, and the interaction between local government and businesses. Further information on this research can be found online at http://www.lincoln.ac.nz/trrec/projects.htm.

1.2 Summary of the Annotated Bibliography

Statistics of the annotated bibliography are as follows;

	Example of Key Search Heading:	**Number Annotated:**
Primary Classification:	Wildlife	128
	Vegetation	60
	Physical	76
	General (multi-classification)	214
Country of Research:	New Zealand	94
	Other countries (including Nepal, Wales, USA, etc.)	384
Environment type:	Coastal	52
	River/lake	42
	Mountain	46
	Grassland & tundra	17
Primary Activities:	Walking/Tramping	191
	Wildlife Viewing	94
	Boating	117
	Camping	96
Primary Impacts:	Erosion	114
	Wildlife disturbance	160
	Water Pollution	47
	Habitat modification	59
Primary Indicators:	Change in species composition	58
	Behavioural change	70
Total Articles Reviewed:		478

1.3 Evaluation of the Literature

One of the major problems in assessing the biophysical impacts of tourism and recreation is the wide variability between activities and the environment they operate in. For example, watching an abundant colony of *Titi* (Mutton bird, *Puffinus griseus*) from well designed, purpose built facilities outside of breeding season would have little discernible impact on the bird population. In contrast, uncontrolled bird watching during the breeding season of the fragile *Toroa* (Northern Royal Albatross, *Diomedea epomophora sanfordi*) may cause extensive disturbance and long term damage to the population. Similarly, tourist activities often result in unintentional 'downstream' impacts. An example, being the camper who increases the risk of fire or exotic species introduction which in turn disrupts local vegetation or wildlife.

Despite this variability, the level of impact tourism inflicts on the biophysical environment usually depends on:

1. The intensity of tourist site-use and development (i.e., the number of tourists, length of stay, their activities, etc);
2. The resiliency/fragility of the ecosystem (e.g., pristine cave with fragile physical formations, flora and fauna);
3. The time perspective of the tourist developer (i.e., a long-term perspective with an interest in protecting the natural asset versus a focus on short-term profit that eventually "destroys the goose that lays the golden egg"); and
4. The transformational character of tourist development (i.e., the extent of modification and change an attraction experiences in response to tourist pressures).

(Cohen 1978, Hammitt & Cole, 1987, Michael Burns & Assoc 1989, Booth & Cullen in Devlin, Corbett & Peebles 1995, Gee 1997)

1.4 Tourism Impacts on Wildlife

While there is species and site-specific variability with regard to the impacts of tourism on wildlife, there are generic impacts that re-occur throughout the literature. These include behavioural changes (such as avoidance and attraction), decreased or disturbed mating and breeding success, displacement, species composition change and population decline. The literature relating to wildlife that is relevant to New Zealand is primarily focussed on bird species and marine mammals. While there is a wide variety of information regarding large terrestrial mammals, this was not considered relevant to New Zealand. There is a lack of information regarding insect communities, the more common bird species and forest species.

Of the bird species reviewed in the literature, consistently occurring impacts included disturbance to normal feeding regimes (either increased feeding from the site or decreased feeding at the site), decreased breeding, nesting, mating and

chick rearing. Avoidance behaviour included taking flight or 'flushing', abandoning nests, moving nests from the view of humans and increased aggressive or protective behaviour. Ultimately these changes may lead to population decline (due to decreased breeding or mating success), over exertion and increased exposure to pressures such as predation and habitat fragmentation.

Similar responses were apparent in other wildlife species including seals and wild ungulates. Notably in the literature regarding campsite use, a change of species composition occurred with increased numbers of scavenger species, such as rodents and certain bird and insect species.

The severity of these impacts depends upon factors such as species characteristics, location and timing of disturbance. In general, wildlife show greater vulnerability to disturbance just prior to and during breeding season. Some wildlife also showed a degree of habituation.

While much of the literature is taken from overseas examples of wildlife that may or may not occur in New Zealand, in most cases the disturbance responses and the ultimate effects of the tourism disturbance are consistent.

While the impact of some tourist activities occurs immediately, others occur over a longer period of time. For example any ground nesting bird that is exposed to motorised vehicles or direct trampling from tourism and recreation activities will be at risk of immediate habitat, nest and chick destruction. Whereas the impacts of habituation, disturbed mating, displacement and overexertion, caused by wildlife viewing may occur over an extended period and go undetected without continuous monitoring.

Common indicators used for monitoring impacts on wildlife included: changes in behaviour (eg., more frequent displays of aggression by seals); displacement (eg., Northern Royal Albatross, Toroa, nesting away from human viewing areas); decreased abundance; and breeding success.

1.5 Tourism Impacts on Vegetation

The impacts of tourism activities on vegetation varies between species, location and season. They also vary depending upon the tourism activity. Generic impacts include loss and/or damage to vegetation, composition change of a plant community, decreased height and area of spread, introduction of exotic species, habitat fragmentation and inhibition of regeneration. The major causes of impact to vegetation include trampling, weed invasion and direct damage (caused for example by removal for development and firewood). The severity of impact on vegetation will likely increase where that vegetation is of critical importance as a species (eg., as an endangered species) or it supports other species (ie., vegetation and wildlife).

Indicators for monitoring vegetation included: loss of vegetation cover; change in species composition (eg., introduction of exotic species/weeds); and regeneration capacity.

1.6 Tourism Impacts on the Physical (abiotic) Environment

The impacts of tourism on the physical (abiotic) environment include soil compaction and structural change (decreased bulk density, etc.), altering the hydrological regime (surface and ground water collection and run-off), increased erosion, sediment disposition, pollution (from chemicals and human waste), damage and/or destruction of formations (eg., speleothems, fossils), changes in temperature and gaseous composition (in caves).

The severity of the impact varies between environment type, climatic conditions, activity type and intensity of use. For example, evidence from research on the St. James walking track (New Zealand), shows that the most severe impact (of erosion and channelling) occurs after rain. Research from sites in North America suggests that higher numbers of tourists using tracks and campsites, relates to an increase in the area affected. Common examples include track widening, increased size of campsite areas and displacement of wilderness seekers to more remote regions.

There is differing evidence on the impacts of motorised versus non-motorised activities to land and water. Much of the literature relates to areas of pre-existing infrastructure where research has not been undertaken prior to the tourism activity. In these circumstances the impact of, for example, dirt bikes as opposed to mountain bikes is similar due to the pre-existing conditions (compaction of tracks etc.). There is a good range of research undertaken regarding off-road vehicles (ie., ORV's or 4WD's). Impacts are more severe where there are no existing pathways, where the activity occurs in fragile environments (eg., wildlife areas, easily erodible sites) and when the usage is high.

The physical indicators for tourism impact included: changes in soil compaction, bulk density, chemical composition, hydrology, the rate of erosion and extent of pollution.

1.7 Discussion

In general, the development of initial, or capital, infrastructure of tourism in a natural area results in the greatest impact. For example clearing forest to build a campsite, viewing platform or walking track results in partial to total habitat modification over a specified area. It also increases the exposure of the habitat to further disturbance. Similarly, the actuality of building a walking track will likely incur soil compaction, changes to the surface water regime, habitat loss and fragmentation, introduction of exotic plants and animals and microclimate changes (such as light and heat increase). Further to this initial impact, the type of maintenance undertaken will have an effect on the health and resilience of the ecosystem to tourism disturbance.

While not considered a direct tourism activity or attraction, the development of supporting facilities such as access roads, accommodation, souvenir shops and service areas is well documented in the literature. These developments can cause partial to complete modification and/or destruction of habitats. The impact is

increased in fragile environments such as coastlines, islands, intact forests and wildlife areas.

The nature of tourists themselves has the ability to increase or decrease the ecological impact of tourism. For example, when visiting natural attractions, some tourists will have more appreciation for potential impacts and thus behave more appropriately. Much of the literature cited human waste disposal, litter, graffiti, vandalism and souveniring as common tourism related impacts. This relates to the awareness of tourists to the environmental impacts of their activities. However, while well maintained sites, or those with interpretation signs, may attract some tourists, they may discourage others. Literature in this bibliography suggests that this has the potential to displace certain tourists further into wilderness and backcountry areas.

It should be noted that not all authors consider tourism and recreation as detrimental to the natural environment with many citing benefits such as increased conservation awareness and increased funding.

1.8 How to use this Bibliography

The major headings of this bibliography are Wildlife, Vegetation, Physical and General. Each paper is classified based on the major emphasis of its research. Those papers that can be classified under more than one major heading are classified as 'general'. The papers are listed in alphabetical order (by author) and numbered throughout the bibliography. A comprehensive key word index can be found from pages 195-205. The key word index allows the reader to search, for example, by tourism activity, impact or species type.

1.9 List of Acronyms & Abbreviations

4WD	Four-wheel drive vehicle
CBA	Cost benefit analysis
CO2	Carbon Dioxide
DoC	Department of Conservation (New Zealand)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
GIS	Geographic Information System
LAC	Limits of acceptable change
Mgmt	Management
NZ	New Zealand
ORV	Off-road vehicle
PNA	Protected Natural Area
ROS	Recreation opportunity spectrum
Spp.	Species
UK	United Kingdom
USA	United States of America
USDA	United States Department of Agriculture
VIM	Visitor Impact Management

Tourism Impacts Literature

2.1 Wildlife

1. **Acero J.M. and Aguirre C.A. 1994 A Monitoring Research Plan for Tourism in Antarctica.** ***Annals of Tourism Research 21 (2): 295-302***

Focus:
Monitoring tourism for Antarctica
Natural Asset:
Ice formations, ice continent
Classification:
Wildlife- also Physical, Freshwater, Coastal/Marine,
Activity:
Boating (cruise ship, small sailing ships); aircraft related trips; walking; skiing (overland travel by ski)
Impact:
Lower reproductive success in penguin colonies exposed to tourism. Some habituation of penguin species
Indicator:
Tourism statistics including number of tourists, frequency of arrival, length of stay, activities. Chinstrap and Adelie penguin behaviour and population dynamics. Abundance and diversity of flora and fauna. Baseline data of geomorphology, climatology, hydrology, biological activity (resting, refuge, transit patterns)

2. **Adams, L.W., Geis, A.D. 1983. Effects of roads on small mammals.** ***Journal of Applied Ecology*** **20: 403-415.**

Focus:
Effects of roads on small mammals
Natural Asset:
Small mammal populations
Classification:
Wildlife (mammals)
Activity:
Land vehicle use (road provision/access to tourist attractions)
Impact:
Altered community structure, increased density, road kills
Indicator:
Change in population/community structure, density

3. **Andersen, D.E., Rongstad, O.J. and Mytton, W.R. 1990. Home-range changes in raptors exposed to increased human activity levels in Southeastern Colorado.** ***Wildlife Society Bulletin 18:*** **134-142.**

Focus:
Impact of human activity on raptors

Natural Asset:
Raptors in Southeastern Colorado
Classification:
Wildlife (birds- raptors)
Activity:
General (human activity- military activity)
Impact:
Increased spatial use of their home range
Indicator:
None

4. Anderson, D.W. and J.O. Keith. 1980. The human influence on seabird nesting success: conservation implications. Biological Conservation 18: 65-80.

Focus:
Human influence on nesting seabirds
Natural Asset:
Brown pelicans *Pelecanus occidentallis californicus* and Heermann's gulls *Larus heermanni* (Gulf of California)
Classification:
Wildlife (birds- seabirds)
Activity:
Photography, sight seeing, wildlife viewing; walking
Impact:
Decreased productivity, loss of eggs/young, increased predation, habitat displacement, infighting, pollution, egg collection, behavioural changes
Indicator:
Amount of footprints/trampling/beer cans/film wrappers, breeding success, productivity, age ratios

5. Andrews, A. 1990. Fragmentation of habitat by roads and utility corridors: a review. *Australian Zoologist 26 (3and4):* 130-141.

Focus:
Habitat fragmentation by roads
Natural Asset:
Australian wilderness areas
Classification:
Wildlife; vegetation
Activity:
Land vehicle use (construction/provision of road access to attractions)
Impact:
Increased wildlife mortality, divided populations, increased invasions of common/ foreign species, increased road-kills, increased human access with negative impacts, wildlife disturbance
Indicator:
Changes in number of 'foreign' species, wildlife mortality, density, diversity distribution, road kills

6. **Ashley, C. 1995. Tourism, communities, and the potential impacts on local incomes and conservation.** ***Research Discussion Paper 10.***

Focus:
Impacts of tourism on wildlife/resource management in Africa
Natural Asset:
Wildlife, social development
Classification:
Wildlife
Activity:
Photography, wildlife viewing
Impact:
Restoration and conservation, economic development, increased pressure on ecological and social resources
Indicator:
Conservation achievements, community well being, wildlife numbers and diversity

7. **Barlow, M. 1995. Habitats and factors affecting breeding success at eleven Caspian Tern** ***Sterna caspia*** **colonies in New Zealand.** ***Notornis 42:138-139.***

Focus:
Disturbance of Caspian Tern
Natural Asset:
Caspian Tern, New Zealand river beds
Classification:
Wildlife
Activity:
Fishing, boating
Impact:
Non-specific
Indicator:
Number of birds/pairs, predation, human activities

8. **Barr, K. and Slooten, E. 1999. Effects of tourism on dusky dolphins at Kaikoura.** ***Conservation Advisory Science Notes No. 229,*** **Department of Conservation, Wellington.**

Focus:
Effects of tourism on dusky dolphins at Kaikoura
Natural Asset:
Dusky dolphins in Kaikoura, NZ
Classification:
Wildlife (mammals- marine/coastal- dusky dolphin)
Activity:
Photography, wildlife viewing, boating, fishing
Impact:
Behavioural changes (leaps and slaps, pod characteristics, directional changes, pod scattering) habituation

Indicator:
Dolphin vocalisations (indicator of feeding activity and success), changes in swimming speed/direction, pod scattering

9. **Bart, J. 1977. Impact of human visitations on avian nesting success.** ***Living Bird 16*****:187-192.**

Focus:
Impact of human visitations on avian nesting success
Natural Asset:
Nesting birds
Classification:
Wildlife, (birds)
Activity:
Photography, wildlife viewing
Impact:
Increased predation by leading predators to nests
Indicator:
Predation rates

10. **Barton, K., Booth, K., Ward, J., Simmons, D.G., Fairweather, J.R. 1998.** ***Visitor and New Zealand Fur Seal Interactions Along the Kaikoura Coast.*** **TREC Report No. 9. Tourism and Research and Education Centre, Lincoln University, New Zealand.**

Focus:
Visitor impacts on NZ fur seals
Natural Asset:
Fur Seals, Kaikoura, New Zealand
Classification:
Wildlife (mammals- fur seals)
Activity:
Photography, wildlife viewing, boating/swimming
Impact:
Displacement to sea or rock crevices, increased awareness, threat responses, physiological impacts (disrupt resting/thermoregulating)
Indicator:
Increased levels of conflict, increased pup mortality, decreased recruitment/return to site

11. **Batcheler, C.L. 1968. Compensatory responses of artificially controlled mammal populations.** ***New Zealand Ecological Society Proceedings*** **15: 25-30.**

Focus:
Artificial control of red deer populations in NZ
Natural Asset:
Red deer populations in NZ
Classification:
Wildlife (mammals- red deer)

Activity:
Hunting
Impact:
Habitat displacement, reduced reproduction, lower fat deposition
Indicator:
Change in population/reproduction rates, habitat shift

12. **Batten, L.A. 1977. Sailing on reservoirs and its effects on water birds. Biological Conservation 11: 49-58.**

Focus:
Sailing and effects on water birds
Natural Asset:
Water birds at the Brent Reservoir, NW London, UK
Classification:
Wildlife, (birds-freshwater/aquatic)
Activity:
Boating (sailing and other recreational boating)
Impact:
Disturbance to nesting, bird behaviour, feeding,
Abandonment of sections of the reservoir or complete abandonment
Indicator:
Tolerance of birds to sailing craft (distance), bird numbers present

13. **Baur, A. and Baur, B. 1990. Are roads barriers to dispersal in the land snail *Arianta arbustorum? Canadian Journal of Zoology 68:* 613-617.**

Focus:
Roads as barriers to land snail dispersal
Natural Asset:
Land snails (*Arianta arbustorum*) in Sweden
Classification:
Wildlife, (land snails)
Activity:
Land vehicle use, roading development (access to attractions)
Impact:
Division of populations, prevention of dispersal, increased mortality, possible breeding decline
Indicator:
No specifics

14. **Beach, D.W. and Weinrich, M.T. 1989. Watching the whales. *Oceanus 32 (1):* 84-88.**

Focus:
Impact of commercial whale watching
Natural Asset:
Whales (especially off N. American coasts)

Classification:
Wildlife (mammal- whales)
Activity:
Photography, wildlife viewing
Impact:
Behavioural change, whale-boat collisions, feeding/resting/socialisation disturbance, abrupt direction/activity changes, noise disturbance, decreased surface times
Indicator:
Indicators difficult to establish as no baseline or 'normal' behaviour for comparison

15. Belanger, L; Bedard, J. 1989. Responses of staging greater snow geese to human disturbance. *Journal of Wildlife Management 53:* 713-719.

Focus:
Responses of Greater Snow Geese to Human Disturbance
Natural Asset:
Greater snow geese (*Chen caerulescens atlantica*) in Montmagny bird sanctuary, Quebec
Classification:
Wildlife (birds)
Activity:
General, boating, hunting, wildlife viewing, photography,
Impact:
Disturbs the bird's feeding, activity budget, distribution, disrupts pair/family bonds,
Indicator:
Time taken for birds to resume feeding or time in flight after a disturbance, percent of flock taking flight after a disturbance.

16. Blane, J.M.; Jaakson, R. 1995. The impact of ecotourism boats on the St Lawrence beluga whales. *Environmental Conservation 21 (3):* 267-269.

Focus:
Impacts of ecotourism boats on St Lawrence Beluga Whales
Natural Asset:
St Lawrence Beluga Whales, Quebec, Canada
Classification:
Wildlife, (mammals)
Activity:
Boating
Impact:
Reduced feeding and nursing, loss of pod integrity, shortened surfacing, displacement from feeding areas, rapid scattering, disruption of social groupings, avoidance of fishing boats.
Indicator:
Whale behaviour: avoidance, time spent at the surface and below, feeding patterns, investigations by whales

17. **Boyle, S.A. and Samson, F.B. 1985. Effects of nonconsumptive recreation on wildlife: a review.** ***Wildlife Society Bulletin 13:*** **110-116.**

Focus:
A review of the effects of nonconsumptive recreation on wildlife
Natural Asset:
General wildlife
Classification:
Wildlife
Activity:
Walking, camping, boating, wildlife viewing, photography, land vehicle use (ORVs, snowmobiles), spelunking/caving, water sports general (swimming, shore recreation), rock climbing
Impact:
Various- habitat trampling, disturbance, litter, pollution (various), change of vegetation/physical environment, behavioural change, habituation, habitat displacement, energy losses
Indicator:
None

18. **Bridson, L. 2000. Minimising visitor impacts on threatened shorebirds and their habitats.** ***Conservation Advisory Science Notes 301.***

Focus:
Minimising impacts of visitors on shorebirds, Waipu and Ruakaka Wildlife refuges Northland NZ
Natural Asset:
Fairy tern *Sterna nereis*, New Zealand dotteral *Charadrius obscurus* variable oyster catcher *Haematopus unicolour,* white fronted tern *Sterna striata,* Caspian tern *Sterna caspia.*
Classification:
Wildlife
Activity:
Beach activities general (swimming, surfing), fishing, boating
Impact:
Disturbance by visitors and dogs at and in environments of breeding areas. Changes in productivity, breeding success. Decline in numbers, displacement
Indicator:
Levels and patterns of visitor use, knowledge of visitors to wildlife, behaviour of visitors to signage, acceptance of visitors to disturbing birds, wildlife biology, population dynamics, changes in behaviour, displacement, breeding success, impact of dogs on beach

19. **Bruinderink, G.W.T.A.G., Hazebroek, E. 1996. Ungulate traffic collisions in Europe.** ***Conservation Biology*** **10: 1059-1067.**

Focus:
Ungulate traffic collisions
Natural Asset:
Ungulate populations in Europe

Classification:
Wildlife
Activity:
Land vehicle use (vehicle transport/access to tourist attractions, road development), sightseeing, photography,
Impact:
Habitat displacement, vehicle collisions with wildlife, wildlife population decline or change in age/sex structure
Indicator:
Incident levels

20. Buick, A.M.; Paton, D.C. 1989 Impact of off-road vehicles on the nesting success of Hooded Plovers *Charadrius rubricollis* in the Coorong region of South Australia. *Emu* 89: 159-172.

Focus:
ORV's and nesting success of Hooded Plovers
Natural Asset:
Hooded Plovers, in the Coorong Region, South Australia
Classification:
Wildlife (birds, coastal/marine)
Activity:
Land vehicle use (ORVs)
Impact:
Interfering with reeding behaviour
Crushing nests
Litter
Increased predation
Indicator:
Vehicle numbers/tracks, crushed nests, plover population, breeding activity, nest attentiveness

21. Burger, J. 1981. The effect of human activity on birds at a coastal bay. *Biological Conservation 21:* 231-241.

Focus:
Impacts of human activity on birds at a coastal bay
Natural Asset:
Birds at the Jamaica Bay refuge along the Atlantic Coast
Classification:
Wildlife (coastal birds)
Activity:
Wildlife viewing, photography, fishing, walking, (and jogging), swimming, aircraft related activity
Impact:
Flushing of birds the only impact discussed
Indicator:
Change in presence of birds with or without humans present,

22. **Burger, J; Gochfeld, M.; Niles, L.J. 1995. Ecotourism and birds in coastal New Jersey: contrasting responses of birds, tourists, and managers.** ***Environmental Conservation 22(1): 56-65.***

Focus:
Ecotourism and its effect on birds
Natural Asset:
New Jersey birds
Classification:
Wildlife (birds)
Activity:
Wildlife viewing, photography
Impact:
Alterations to bird behaviour, reproduction, migration, and population levels. Also nest abandonment, nesting/feeding in sub-optimal areas.
Indicator:
Density of bird populations, breeding success, changed tolerance/responses by birds

23. **Busack, S.D. and Bury, R.B. 1974. Some effects of off-road vehicles and sheep grazing on lizard populations in the Mojave Desert.** ***Biological Conservation 6:*** **179-183.**

Focus:
Effects of ORVs and sheep grazing on lizard populations
Natural Asset:
Lizard populations in the Mojave Desert
Classification:
Wildlife (reptiles-lizards)
Activity:
Land vehicle use (ORVs, 4Wdriving)
Impact:
Loss of vegetation/ground cover necessary for some lizards, reduction of invertebrate food sources, crushing/death, disturbance
Indicator:
Change in numbers or biomass of lizards

24. **Canaday, C. 1996. Loss of insectivorous birds along a gradient of human impact in Amazonia. Biological Conservation 77: 63-71.**

Focus:
Human impacts on insectivorous birds in Amazonia
Natural Asset:
Bird life in Cuyabeno Wildlife Production Reserve in NE Ecuador
Classification:
Wildlife (birds)
Activity:
Hunting, facility development, tourist service provision (eg. Accommodation)
Impact:
Population decline, habitat displacement, behaviour change, increased predation,

Indicator:
Population change in sensitive spp (not total spp richness which may mask at risk spp)

25. **Carothers, S.W., and Aitchison, S.W. 1976. An ecological study of the riparian zone of the Colorado River between Lees Ferry and the Grand Wash Cliffs, Arizona.** ***Colorado River Tech.Res.10, Grand Canyon National Park, Arizona: 251***

Focus:
Impacts of tourism/recreation on wildlife, Grande Canyon National Park USA
Natural Asset:
Colorado river/Grande canyon national park
Classification:
Wildlife
Activity:
Boating (eg. rafting, kayaking),walking, camping
Impact:
Changes in species composition due to attraction/avoidance to disturbance, high numbers of rock squirrels and mule deer from feeding by hikers; decreased populations of lizards through reduction of driftwood required for shelter/foraging; destruction of nests/burrows of ground dwelling invertebrates
Indicator:
Species diversity, abundance, composition, habituation, avoidance/attraction, site damage

26. **Chester, J.M 1976.** ***Human wildlife interactions in the Gallatin Range, Yellowstone National Park, 1973-1974.*** **M.S. thesis; Montana State University; Bozeman; pp114.**

Focus:
Relationship between human use and frequency of wildlife observation
Natural Asset:
Wildlife, Gallatin range, Yellowstone National Park, USA
Classification:
Wildlife
Activity:
Walking
Impact:
General disturbance
Indicator:
Profile of visitors, frequency and nature of wildlife encounters, seasonal/spatial circumstances

27. **Clevenger, G.A and Workman, G.W. 1977. The effects of campgrounds on small mammals in Canyonlands and Arches National Park.** ***Trans. North American Wildlife Natural Resource Conference 42:473-484***

Focus:
Effects of camp grounds on small mammals, Canyonlands and Arches National Park, USA
Natural Asset:
Wildlife in natural areas
Classification:
Wildlife
Activity:
Camping
Impact:
Change in species composition, increased numbers of opportunistic feeders eg rats, chipmunks; change in behaviour of species attraction/avoidance
Indicator:
Species composition, abundance, species behaviour, visitor profile and nature

28. **Constantine, R. and Baker, C.S. 1997. Monitoring the commercial swim-with-dolphin operations in the Bay of Islands.** ***Science for Conservation 56.***

Focus:
Monitoring commercial swim-with-dolphin operations on the Bay of Islands
Natural Asset:
Common and bottlenose dolphins, coastal marine environments, Bay of Islands
Classification:
Wildlife
Activity:
Swimming, boating
Impact:
Habitat degradation, disturbance, pollution, feeding by hand, behavioural change including attraction or avoidance
Indicator:
Tourism activity statistics, attraction/avoidance behaviour, changes in socialisation behaviour, displacement, numbers

29. **Constantine, R. 1999. Effects of tourism on marine mammals in New Zealand.** ***Science for Conservation: 106.***

Focus:
Marine Mammals
Natural Asset:
Focal wildlife (whales, dolphins, seals) and marine ecosystem
Classification:
Wildlife (marine/Coastal)
Activity:
Wildlife viewing, swimming with dolphins

Impact:
Wildlife disturbance, via vessel noise, swimming, possible acoustic impacts
Indicator:
Management ie. number and type of permits, education value of experience, behavioural change in response to vessels and swimming.

30. **Corkeron, P.J. 1995. Humpback whales (*Megaptera novaeanliae*) in Hervey Bay, Queensland: Behaviour and responses to whale-watching vessels. *Canadian Journal of Zoology 73:* 1290-1299.**

Focus:
Whale-watching impacts on humpback whales
Natural Asset:
Humpback whales (*Megaptera novaeangliae*), Hervey Bay, Queensland, Australia
Classification:
Wildlife (mammals- Humpback whales)
Activity:
Wildlife viewing, photography
Impact:
Behavioural change (diving, fewer surface behaviours)
Indicator:
No specifics

31. **Culik, B. and Wilson, R. 1991. Penguins Crowded Out?** ***Nature 351:340.***

Focus:
Susceptibility of Adelie and chinstrap penguins to human interference.
Natural Asset:
Adelie and chinstrap penguins
Classification:
Wildlife
Activity:
Walking, aircraft related activities, science monitoring.
Impact:
Effects of stress, behavioural change, over exertion, physiological changes, abandoning nests causing reduced breeding success. Penguins deaths from surface active agents (oil, detergents)
Indicator:
Nest displacement, heart rate, fleeing to sea, population dynamics in relation to human, activity, changes in behaviour and energetics when 'tagged' for monitoring

32. Curry, S. 1983. "Tourism Circuit Planning: Capacity at Ngorongoro Crater, Tanzania". Pp. 67-80 in University of Bradford. *The Impact of Tourism and Recreation on the Environment, Occasional Paper No. 8.* University of Bradford.

Focus:
Tourist capacity planning at Ngorongoro Crater, Tanzania
Natural Asset:
Ngorongoro Crater, Tanzania
Classification:
Wildlife
Activity:
Wildlife viewing, facility development
Impact:
Wildlife disturbance/behavioural change, excessive tourist development
Indicator:
Carrying capacity based on number of vehicles viewing and the length of time spent viewing the wildlife

33. deGroot, R.S., 1983. Tourism and conservation in the Galapagos Islands. Biological Conservation, 26: 291-300.

Focus:
Tourism and the Galapagos Islands
Natural Asset:
Wildlife on the Galapagos Islands
Classification:
Wildlife
Activity:
Wildlife viewing, walking, boating
Impact:
Litter, wildlife disturbance/habituation, weed intro, souveniring,
Indicator:
Presence of litter, wildlife behavioural change

34. Duffus, D.A. and Dearden, P. 1990. Non-consumptive wildlife-oriented recreation: A conceptual framework. *Biological Conservation 53:* 213-231.

Focus:
A conceptual framework of non consumptive wildlife oriented recreation
Natural Asset:
General wildlife assets
Classification:
Wildlife
Activity:
Wildlife viewing (include bird watching, whale watching), photography, walking
Impact:
Not discussed
Indicator:
None specified

35. **Duffus, D.A., Dearden, P. 1993. Recreational use, valuation, and management of killer whales (*Orcinus orca*) on Canada's Pacific coast. *Environmental Conservation 20(2):* 149-156.**

Focus:
Recreational use, valuation and mgmt of Canada's Killer whales
Natural Asset:
Killer whales (*Orcinus orca*) along Canada's Pacific Coast
Classification:
Wildlife (mammals- Killer whales)
Activity:
Wildlife viewing (whale watching), boating,
Impact:
Behavioural changes, collision, interference with feeding, courtship or care of juveniles, alteration of range, increased energy consumption,
Indicator:
Changes in behaviour, range

36. **Duffus, D.A. 1996. The recreational use of grey whales in southern Clayoquot Sound, Canada. *Applied Geography 16 (3):* 179-190.**

Focus:
Recreation use of grey whales
Natural Asset:
Grey whales in southern Clayoquot Sound, Canada
Classification:
Wildlife (marine mammals)
Activity:
Wildlife viewing (whale watching)
Impact:
Whale shift from feeding sites
Indicator:
Yearly feeding site trends

37. **Duffy, E. 1975. The human effects of trampling on the fauna of grassland litter. *Biological Conservation 7*: 255-274.**

Focus:
Trampling on the fauna of grass litter
Natural Asset:
General grassland fauna
Classification:
Wildlife, (invertebrate), Vegetation
Activity:
Walking
Impact:
Decreased in invertebrate numbers and spp,
Indicator:
Changes in: leaf litter composition and amount, population/spp numbers

38. Dunaway, D.J. 1971. Human disturbance as a limiting factor of Sierra Nevada bighorn sheep. In *Transactions of the North American Wild Sheep Conference*, 1: 165-173.

Focus:
Human disturbance of mountain sheep
Natural Asset:
Sierra Nevada bighorn sheep
Classification:
Wildlife (mountain sheep)
Activity:
General including walking, hunting, wildlife viewing, camping
Impact:
Disturbance/behavioural change, habitat displacement, intro of parasites/disease, increased risk of predation, population decline
Indicator:
Population decline, change/movement of habitat

39. Fahrig, L., Pedlar, J.H., Pope, S.E., Taylor, P.D., Wegner, J.F. 1995. Effect of road traffic on amphibian density. *Biological Conservation* 73: 177-182.

Focus:
Effect of road traffic on amphibian density
Natural Asset:
Anurans (frogs/toads)
Classification:
Wildlife
Activity:
Land vehicle use (road traffic, travel to attractions/activities etc)
Impact:
Population and distribution decline, altered population characteristics (eg few adult/large anurans)
Indicator:
Traffic intensity, presence of road killed anurans, population change

40. Fernandes L., Ridgley M.A. and van't Hof, T. 1999 Multiple criteria analysis integrates economic, ecological and social objectives for coral reef managers Environmental Management 18(4):393-402

Focus:
Multiple criteria analysis for management of coral reefs (social, ecological and economic values)
Natural Asset:
Coral reef ecosystems
Classification:
Wildlife
Activity:
Water sports general (diving, snorkelling), boating

Impact:
General inclusive ecological/social/economic
Indicator:
None specified

41. **Fraser, W. 1996. The effect of recreational hunters on deer populations in Pureora Conservation Park.** ***Science for Conservation 31.***

Focus:
Effects of recreational hunters, Pureora NZ
Natural Asset:
Pureora Conservation Park NZ
Classification:
Wildlife- (also secondary impacts on vegetation)
Activity:
Hunting
Impact:
Vegetation restoration/decreased browsing pressure in certain areas (related to access).
Indicator:
Deer population and dispersal, hunter data, kill rates, number of hunters and profiles, sightings etc., deer population information ie. gender, age etc., faecal pellet

42. **French, J.M.** ***1972 Distribution, abundance, and breeding status of osprey in northwestern California.*** **Humbolt State University; California**

Focus:
Effects of disturbance on osprey
Natural Asset:
Osprey, California USA
Classification:
Wildlife
Activity:
General
Impact:
Displacement, abandoning nests, changes in behaviour
Indicator:
Displacement, changes in behaviour, nest abandonment, breeding/fledgling success

43. **Garton, E.O, Bowen, C.W and Foin, T.C. 1977. The impacts of visitors on small mammal communities of Yosemite National Park.** ***In Visitor impacts on National Parks: The Yosemite ecological impact study.*** **pp 44-49 T.C. Foin (ed); University of California; USA**

Focus:
Visitor impacts on small mammal populations
Natural Asset:
Wildlife in natural areas, Yosemite National Park
Classification:
Wildlife
Activity:
Camping, walking
Impact:
Increased numbers of mice. Decreased numbers of voles in response to trampling of vegetation.
Indicator:
Change in species composition, abundance, distribution

44. **Garton, E.O, Hall, B. and Foin, T.C. 1977. The impact of a camp ground on the bird community of a lodgepole pine forest.** ***In Visitor Impacts on National Parks: The Yosemite ecological impact study.*** **pp37-43. T.C. Foin (ed) University of California; USA**

Focus:
Impact of visitor to camp grounds on bird species
Natural Asset:
Wildlife in natural areas, Yosemite National Park
Classification:
Wildlife
Activity:
Camping, walking
Impact:
Modification of vegetation resulting in bird species composition change, disturbance causing attraction/avoidance behaviour, increase of scavenging/opportunistic feeding/feeders on food scraps
Indicator:
Change in species composition, abundance, distribution, litter

45. **Ghazanshahi, J., Huchel, T.D., Devinny, T.S. 1983. Alternation of Southern California Rocky Shore Ecosystems by Public Recreational Use.** ***Journal of Environmental Management 16(4)*** **379-394.**

Focus:
Intertidal ecosystems
Natural Asset:
Southern California rocky shores
Classification:
Wildlife

Activity:
Public recreation use:, Walking, Fossicking, Collecting, Other
Impact:
Trampling of organisms, Taking of organisms, Disturbance i.e. poking anemones, Indirect alteration of ecological balance
Indicator:
Counts of people present at specific times, General surveys of biological communities (number of species), Surveys of suspect species- likely to be affected by public

46. **Gordon, J.; Leaper, R.; Hartley, F.G.; Chappell, O. 1992. Effects of whale-watching vessels on the surface and underwater acoustic behaviour of sperm whales off Kaikoura, New Zealand.** ***Science and Research Series 52.*** **Department of Conservation, Wellington.**

Focus:
Effects of whale watching vessels on acoustic behaviour of Kaikoura's sperm whales
Natural Asset:
Sperm whales, Kaikoura, NZ
Classification:
Wildlife, (marine mammals)
Activity:
Wildlife viewing (whale watching)
Impact:
Behavioural disturbances (longer diving periods, shorter surface times, diving without tail fluking)
Indicator:
Time spent above and below the surface. Diving behaviours. Boat activity/ behaviour.

47. **Groom, M.J. 1990. Management of ecotourism in Manu National Park, Peru: controlling negative effect on beach-nesting birds and other riverine animals. In Kusler, J. (ed.)** ***Proceedings from the Second International Symposium: Ecotourism and Resource Conservation, November 27- December 2, 1990.*** **Miami Beach, Florida: Association of Wetland Managers.**

Focus:
Ecotourism impacts on beach nesting birds and riverine wildlife
Natural Asset:
Beach nesting birds and riverine wildlife in Manu Biosphere Reserve, Peru.
Classification:
Wildlife
Activity:
Wildlife viewing, camping, boating
Impact:
Breeding disturbance, nest abandonment, increased predation, behavioural change (fleeing), animal harassment,

Indicator:
Tendency of birds to flush/flee when approached, nesting losses/success rates,

48. Hand, J.L. 1980. Human disturbance in western gull *Larus occidentalis livens* colonies and possible amplification by intraspecific predation. *Biological Conservation 18:* 59-63.

Focus:
Human disturbance in western gull colonies
Natural Asset:
Western Gulls (*Larus occidentalis livens*) in the Gulf of California
Classification:
Wildlife
Activity:
Wildlife viewing Walking, boating, camping, swimming, sunbathing
Impact:
Lower reproductive rates, decline in numbers, egg exposure and chick attack through displacement of adults, predation of eggs and attack of adults from other adults that have lost eggs.
Indicator:
Change in number of nests, eggs, chicks, aggressive and predatory behaviour following/during disturbance, displacement

49. Havera, S.P., Boens, L.R., Georgi, M.M. and Shealy, R.T. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. *Wildlife Society Bulletin 20:* 290-298.

Focus:
Human disturbance of waterbirds (diving ducks)
Natural Asset:
Keokuk Pool, Mississippi River
Classification:
Wildlife (birds-waterbirds)
Activity:
Boating, fishing, camping, picnicking, hunting,
Impact:
Habitat displacement, behavioural change, energy loss,
Indicator:
Changes in bird population, distribution

50. HaySmith, L. and Hunt, J.D. 1995. Nature tourism: Impacts and management. pp 203-219 in Knight, R.L. and Gutzwiller, K.J. (Eds) 1995. *Wildlife and recreationists: coexistence through management and research.* Island Press, Washington DC.

Focus:
Impacts of nature tourism on wildlife
Natural Asset:
General

Classification:
Wildlife
Activity:
General including Boating, walking, land vehicle use, wildlife viewing
Impact:
Direct- including behavioural and physiological change, death, displacement, decreased reproduction/breeding, increased predation, nest/offspring abandonment, habituation
Indirect- including damage to vegetation and physical assets, habitat modification, waste disposal, demand for wildlife threatening services/products (eg grazing for cows for milk)
Indicator:
Behavioural/breeding/population changes, impact recovery times
Recommends the use of ROS, GIS, LAC and VIM in evaluating and implementing mgmt strategies

51. Henson, P. and Grant, T.A. 1991. The effects of human disturbance on Trumpeter Swan breeding behaviour. ***Wildlife Society Bulletin 19:*** **248-257.**

Focus:
Human disturbance impacts on Trumpeter Swan breeding
Natural Asset:
Trumpeter Swans, Copper River Delta, Alaska
Classification:
Wildlife (birds- Trumpeter Swans)
Activity:
Aircraft related activities, land vehicle use, walking, wildlife viewing
Impact:
Nest abandonment, habitat displacement, behavioural changes, increased nest predation, increased embryo mortality, energy loss
Indicator:
Changes in productivity levels, populations

52. Hicks, L.L. 1977. ***Human disturbance of the Mount Baxter herd of Sierra Nevada bighorn sheep.*** **MS thesis, University of Michigan, Ann Arbor, USA.**

Focus:
Human disturbance of mountain sheep in the Sierra Nevada
Natural Asset:
Mountain sheep in the Sierra Nevada
Classification:
Wildlife (mountain sheep)
Activity:
General including Walking, hunting, wildlife viewing, camping
Impact:
Habitat displacement, fleeing, behavioural change/habituation, disturbance
Indicator:
Change in habitat location

53. **Horejsi, B. 1976. Some thoughts and observations on harassment and bighorn sheep. Pp. 149-155 in *Northern Sheep Council Proceedings,* Jackson, Wyoming, USA.**

Focus:
Harassment of bighorn sheep
Natural Asset:
Bighorn sheep
Classification:
Wildlife (mountain sheep)
Activity:
Ski-field development, skiing, hunting, walking, camping
Impact:
Harassment, habitat displacement, fleeing, behavioural change, habituation
Indicator:
Changes in behaviour

54. **Horwich, R.H and Lyon, J. 1999. Rural Ecotourism as a Conservation Tool. In Singh, T.V and Singh, S. *Tourism Development in Critical Environments.* Cognizant Communication Corporation; New York. Pp.102-119.**

Focus:
Rural eco-tourism as a conservation tool, Community Baboon Sanctuary
Natural Asset:
Rural settings
Classification:
Wildlife (also vegetation)
Activity:
Wildlife viewing, photography
Impact:
Positive impacts of conservation of baboon through community rural programs
Indicator:
None specified

55. **Hosier, P.E., Kochar, M., Thayer, V. 1981. Off-road vehicle and pedestrian traffic effects on the sea-approach of hatchling Loggerhead Turtles. *Environmental Conservation 8:* 158-161.**

Focus:
ORV and pedestrian track effects on Loggerhead turtles
Natural Asset:
Hatchling Loggerhead Turtles, North Carolina
Classification:
Wildlife (Loggerhead turtles)
Activity:
Land vehicle use (ORVs, 4Wdriving), walking
Impact:
Track formation resulting in the disruption of turtles reaching the sea resulting in increased predation and stress

Indicator:
None

56. Hubert, Wayne A. and Gipson, Robert D. 1996 Angler Survey Contributes to Socially Acceptable Modification of Harvest Regulations to Preserve Cutthroat Trout Fishery in Snake River, Wyoming, USA ***Environmental Management 20:707-713***

Focus:
Impact of angler preference on fishing harvest, Wyoming USA
Natural Asset:
Fresh water ecosystems,
Classification:
Wildlife
Activity:
Fishing
Impact:
Decreased stock numbers and species type.
Indicator:
Angler preference in ways/areas of fishing, angler numbers and activities, stock numbers in relation to fishers, changes in ecosystem condition in relation to fishers numbers and activities

57. Hulbert, I.A.R. 1990. The response of Ruddy Shelduck *Tadorna ferruginea* to tourist activity in the Royal Chitwan National Park of Nepal. ***Biological Conservation 52:*** **113-123.**

Focus:
Response of Ruddy Shelduck to tourist activity
Natural Asset:
Ruddy Shelducks (*Tadorna ferruginea*) in the Royal Chitwan National Park, Nepal
Classification:
Wildlife (birds- Ruddy shelduck)
Activity:
Boating (canoeing)
Impact:
No impact
Indicator:
Change in number of birds returning each season

58. Humprey, S.R. 1978. Status, winter habitat and management of the endangered Indiana bat, ***Myotis sodalis. Fla.Sci.41(2):65-76.***

Focus:
Effects of disturbance on Indiana bat
Natural Asset:
Indiana bat

Classification:
Wildlife
Activity:
Caving, wildlife viewing
Impact:
Disturbance (in part) causing decline of numbers; increased air temperatures from construction at cave entrances causing increased metabolism in hibernating bats decreased survival
Indicator:
Changes in metabolism, population dynamics/abundance, changes in air temperature pre disturbance

59. Jacobsen, S. and Lopez. 1994. Biological Impacts and Eco-tourism: Tourists and Nesting turtles in Tortuguero National Park, Costa Rica. ***Wildlife Society Bulletin 22(3).***

Focus:
Nesting turtles
Natural Asset:
Tortuguero National Park Costa Rica
Classification:
Wildlife (Beach Turtles)
Activity:
Eco-tourism nightly observations
Impact:
Behavioural changes and disturbance trampling of hatchings
Indicator:
Visitor numbers, successful nestings, false nests, unsuccessful nesting.

60. Jeffs, A. 1993. ***The impacts of a glass-bottom boat operation in Goat Island Bay.*** **Auckland.**

Focus:
Impacts of boating tourism in Goat Island Marine reserve
Natural Asset:
Goat Island Bay Marine Reserve, Nth Is, NZ
Classification:
Wildlife (fish/bird marine)
Activity:
Boating
Impact:
Attraction or repulsion of diff fish species, possible interference with bird roosting/feeding/nesting sites, disturbance to seashore flora and fauna
Indicator:
Fish and bird behavioural changes, abrasion crushing of the shore and its flora/ fauna

61. **Kahl, R. 1991. Boating disturbance of Canvasbacks during migration at Lake Poygan, Wisconsin.** ***Wildlife Society Bulletin 19:*** **242-248.**

Focus:
Boating disturbance of Canvasbacks during migration
Natural Asset:
Canvasbacks, Lake Poygan, Wisconsin
Classification:
Wildlife (birds- Canvasbacks)
Activity:
Boating, fishing
Impact:
Habitat degradation (eutrophication, sedimentation, carp, higher water levels), habitat displacement, behavioural change, energy loss,
Indicator:
None

62. **Kazmierow, B.J. 1996.** ***Ecological and human dimensions of tourism-related wildlife disturbance at the Waitangiroto White Heron (Kotuku) colony, South Westland, New Zealand.*** **MSc. Thesis, Lincoln University, New Zealand.**

Focus:
Tourism related disturbance at the Waitangiroto White Heron Colony, NZ
Natural Asset:
Waitangiroto White Heron Colony, South Westland, NZ
Classification:
Wildlife (bird- wetland)
Activity:
Wildlife viewing, boating (jet boating, kayaking, outboard), aircraft related activities (overflights, helicopter flights)
Impact:
Fleeing, feeding disturbance, behavioural changes, habitat displacement,
Indicator:
Presence of black swans (indicator of disturbance), change in habitat location/ river use/bird behaviour

63. **Keller, V. 1989. Variations in the response of Great Crested Grebes** ***Podiceps cristatus*** **to human disturbance- A sign of adaptation?** ***Biological Conservation 49:*** **31-45.**

Focus:
Response of Great Crested Grebes to human disturbance
Natural Asset:
Great Crested Grebes (*Podiceps cristatus*) in Switzerland
Classification:
Wildlife (birds- Great Crested Grebes (*Podiceps cristatus*))
Activity:
Boating (including canoeing), swimming, walking, fishing,

Impact:
Decline in breeding populations, nest abandonment, lower hatching success, increased predation, flushing, behavioural change (reduced nest building)
Indicator:
Changes in breeding populations, hatching success

64. **Korschgen, C.E., George, L.S. and Green, W.L. 1985. Disturbance of diving ducks by boaters on a migrational staging area.** ***Wildlife Society Bulletin 13:*** **290-296.**

Focus:
Disturbance by boaters on diving ducks
Natural Asset:
Diving ducks on a migrational staging area, Upper Mississippi River, USA
Classification:
Wildlife (waterbird)
Activity:
Boating
Impact:
Dispersal, behavioural change, feeding/resting disturbance, habitat displacement
Indicator:
None

65. **Kovacs, K.M. and Innes, S., 1990. The Impact of Tourism on Harp Seals (*Phoca groenlandica*) in the Gulf of St. Lawrence, Canada.** ***Applied Animal Behaviour Science 26 Nos. 1-2: 15-26***

Focus:
Impact of tourism on behaviour of female harp seals and pups.
Natural Asset:
Wildlife: Harp Seals (Canada)
Classification:
Wildlife Harp seal (*Phoca groenlandica*)
Activity:
Viewing and sometimes touching wildlife, helicopter flights (aircraft related) to seal colonies
Impact:
Changes in behaviour, nursing activities, fleeing to the water, increased energy exertion, increased antagonistic behaviour, possible desertion of, and injury to pups, possible displacement of pups.
Indicator:
Changes in nursing behaviour, pup activity, tourist behaviour and frequency, resumption of pre-distraction behaviour

66. **Kuchel, C.R. 1977.** ***Some aspects of the behaviour and ecology of harlequin ducks breeding in Glacier National Park.*** **University of Montana; USA**

Focus:
Effects of human disturbance on Harlequin ducks
Natural Asset:
Freshwater Harlequin ducks
Classification:
Wildlife
Activity:
Water related activities (River, stream), fishing, walking, boating
Impact:
General
Indicator:
Breeding success, evidence of polluted water, disturbed environment, disturbance from human activities

67. **Kury, C.R. and M. Gochfield. 1975. Human interference and gull predation in cormorant colonies.** ***Biological Conservation*** **8: 23-24.**

Focus:
Human interference and gull predation in cormorant colonies
Natural Asset:
Double-crested cormorant (*Phalacrocorax auritus)* and king shag (*P. albi-venter)*
Classification:
Wildlife (birds-seabirds)
Activity:
Wildlife viewing, walking, photography
Impact:
habituation, predation, fish-regurgitation (to sate egg/young predators), fleeing, behavioural change (aggression), damage to eggs,
Indicator:
Incubation/nestling success, predation levels, productivity

68. **Lord, A., Waas, J.R. and Innes, J. 1996. Effects of human activity on the behaviour of northern New Zealand dotterel** ***Charadrius obscurus aquilonius*** **chicks.** ***Biological Conservation 82:15-20.***

Focus:
Effects of human activity on dotterel chick behaviour
Natural Asset:
Northern NZ Dotterel (*Charadrius obscurus aquilonius*) chicks
Classification:
Wildlife (birds- marine/coastal- seabirds)
Activity:
General beach activities, swimming, dog walking, land vehicle use (access)

Impact:
Altered feeding behaviour/practices, brood desertion, crushing of nests, increased risk of chick and nest predation, displacement to alternative and suboptimal feeding zones resulting in energetic constraints.
Indicator:
Time budgets with without disturbance, foraging behaviour/time
Changes in behaviour including amount of time spent foraging in specific area

69. Lott, D.F. and McCoy. 1995. Asian Rhinos *Rhinoceros unicornis* on the run? Impact of tourist visits on one population. *Biological Conservation 73(1):* 23-26.

Focus:
Elephant birth tours to sightsee rhino
Natural Asset:
Chitwan Park Nepal
Classification:
Wildlife (rhino's)
Activity:
Elephant riding
Impact:
Changes in rhino behaviour
Indicator:
Changes in rhino behaviour; alertness, walking, feeding

70. MacGibbon, J. 1991. *Responses of sperm whales (Physeter macrocephalus) to commercial whale watching boats off the coast of Kaikoura.* Unpublished report, Department of Conservation, Wellington.

Focus:
Whale watching boat impacts on sperm whales
Natural Asset:
Sperm whales *(Physicaleter macrocephalus)* off the coast of Kaikoura, New Zealand
Classification:
Wildlife (mammals-Sperm Whales)
Activity:
Wildlife viewing (Whale watching), boating
Impact:
Behavioural changes (including. respiration interval, length of submergence, surfacing length, speed and orientation on surface, occurrence of hasty dives and aerial behaviour)
Indicator:
Changes in behaviour (including. respiration interval, length of submergence, surfacing length, speed and orientation on surface, occurrence of hasty dives and aerial behaviour)

71. **MacGibbon, J. 1990.** ***Responses of Sperm Whales, Physeter Macrocephalus, to Commercial Whale Watching Boats off the Coast of Kaikoura*** **(unpublished report).**

Focus:
Sperm Whales
Natural Asset:
Ocean
Classification:
Wildlife (whales)
Activity:
Viewing (Whale-watching)
Impact:
Behavioural changes to whales
Indicator:
Respiration intervals, submergence intervals at surface, speed on surface, changes in orientation and aerial behaviours

72. **Madsen, J. 1995. Impacts of disturbance on migratory waterfowl.** ***IBIS 137 (Supplement 1):*** **67-74.**

Focus:
Impacts of disturbance on migratory waterfowl
Natural Asset:
General migratory waterbird populations
Classification:
Wildlife (birds- migratory waterfowl)
Activity:
Hunting, aircraft related activities, boating, fishing, walking, sailing, windsurfing
Impact:
Habitat displacement (temperature and spatial), behavioural change (dispersal, habituation), energy loss, feeding disturbance
Indicator:
Changes in bird habitat, population, behaviour

73. **Mahoney, C.L. 1976. Soil insects as indicators of use patterns in recreation areas.** ***Journal of Forestry 74(1):35-37***

Focus:
Insect populations as indicators for the intensity if use of camp grounds
Natural Asset:
Insect populations
Classification:
Wildlife
Activity:
Camping
Impact:
Reduction in numbers of individuals and species, changes in species composition
Indicator:
Species diversity, community structure, abundance, intensity of camp ground use

74. **Marret, R., 1992. Underwater noise from tourist operations.** ***Conservation Advisory Science Notes 1***

Focus:
Noise of tourist operations and possible impact on marine wildlife.
Natural Asset:
Marine wildlife, cetaceans
Classification:
Wildlife
Activity:
Wildlife viewing (from boats and helicopters).
Impact:
Behavioural changes of wildlife; whales surfacing more often to lessen noise, signs of disturbance with sudden noise.
Indicator:
Changes in: surfacing frequency, pod activity

75. **McIntyre, J.M.W. 1977. Spring calls the loons.** ***Minnesota Volunteer Marine reserve-Apr.:22-26***

Focus:
Effects of recreationists on loons
Natural Asset:
Freshwater loons
Classification:
Wildlife
Activity:
Camping, canoeing, kayaking (boating), water recreation

Impact:
Abandonment of nests leaving eggs and chicks vulnerable to predators, resulting in decreased fledgling success.
Indicator:
Abandonment of nests, predation on chicks, changes in behaviour

76. **Meyer, E. 1993. The impact of summer and winter tourism on the fauna of alpine soils in western Austria.** ***Revue Suisse de Zoologie 100(3):519-527.***

Focus:
Impact of summer and winter tourism on fauna of alpine soils in Austria
Natural Asset:
Alpine vegetation, Austria
Classification:
Wildlife
Activity:
Snow related activities, snow mobiles, skiing, snowboarding, bull dozers, walking

Impact:
Trampling of vegetation in summer. Over heating, desiccation and erosion during summer impair edaphic conditions. Reduction of earthworm abundance . compaction, reduction of total fauna abundance, increase of bare ground.
Indicator:
Bare ground, species abundance and diversity, activity nature, spatial and temporal characteristics

77. **Montgomery, P.J. 1991.** ***The effects of water-based recreational disturbance on water-birds at Lake Rotoiti, Rotorua.*** **A report for the Royal Forest and Bird Protection Society, the Department of Conservation and the Ministry for the Environment, Technical Report Series No 14, Department of Conservation, Rotorua.**

Focus:
Water based recreational disturbances on water birds
Natural Asset:
Water birds at Lake Rotoiti, Rotorua, New Zealand
Classification:
Wildlife (freshwater birds)
Activity:
Boating, waterskiing, fishing, swimming,
Impact:
Habitat displacement, feeding/resting/breeding disturbance, energy loss, nest destruction
Indicator:
Change in bird abundance and diversity and disturbance related incidents

78. **Munguira, M.L., Thomas, J.A. 1992. Use of road verges by butterfly and burnet populations, and the effect of roads on adult dispersal and mortality.** ***Journal of Applied Ecology*** **29: 316-329.**

Focus:
Effects of roads on butterfly and burnet (moth) populations
Natural Asset:
Butterfly and moths in the UK
Classification:
Wildlife (insects-butterfly's/moths)
Activity:
Land vehicle use
Impact:
Change to population, density, movement, diversity of butterflys
Indicator:
Change in species richness/diversity, movement

79. Myers, N. 1972. National Parks in Savannah Africa: ecological requirements of parks must be balanced against socio-economic constraints in their environments. ***Science*** **178(4067): 1255-1263.**

Focus:
Tourist impacts in National Parks in Savanna Africa
Natural Asset:
National Parks in Savanna Africa
Classification:
Wildlife
Activity:
Wildlife viewing, safari tours, photography
Impact:
Artificial habitat modification, wildlife distraction/disturbance
Indicator:
None specified

80. Nimon, A.J, Schroter, R.C and Stonehouse, B. 1995. Heart rate of disturbed penguins. ***Nature 374: 415.***

Focus:
Physiological effects of disturbance on penguins.
Natural Asset:
Adelie andchinstrap penguins
Classification:
Wildlife
Activity:
Wildlife viewing
Impact:
Disturbance and stress impacting on breeding success. avoidance to pedestrians and aircraft, heart rate increase with sight and approach of humans.
Indicator:
Heart rate, behavioural changes

81. Owens, N.W. 1977. Responses of wintering brent geese to human disturbance. ***Wildfowl 28:*** **5-14.**

Focus:
Responses of Brent Geese to human disturbance
Natural Asset:
Wintering dark-bellied Brent Geese, Essex, UK
Classification:
Wildlife (birds- Brent Geese (*Branta bernicla bernicla*))
Activity:
Boating, aircraft related activities, hunting, fishing, walking
Impact:
Lost feeding time, dispersal, behavioural change, habituation, extra time spent in flight, habitat displacement
Indicator:
Change in feeding time

82. **Parent, C. and Weatherhead, P.J. Behavioural and life history responses of eastern massasauga rattlesnakes (*Sistrurus catenatus catenatus)* to human disturbance *http://link.springer.de/search.htm***

Focus:
Responses of rattlesnake to human disturbance
Natural Asset:
Rattlesnake
Classification:
Wildlife
Activity:
General including walking and land vehicle use
Impact:
Avoidance response of breeding females, possible long term effects
Indicator:
Increase distance of gravid snakes to human disturbance, number of sightings of snakes

83. **Pedevillano, C and Wright, R.G. 1987. The influence of visitors on mountain goat activities in Glacier National Park, Montana. *Biological Conservation 39:* 1-11.**

Focus:
The influence of visitors on mountain goat activities
Natural Asset:
Mountain goats in Glacier National Park, Montana
Classification:
Wildlife (mountain goats)
Activity:
Walking, wildlife viewing, land vehicle use
Impact:
Park users had no significant impact, traffic caused behavioural change in goats crossing the highway with run backs, hesitation and visual alarm responses
Indicator:
Changes in spatial distribution of goats (e.g. their use of a mineral lick)

84. **Pierce, R.J. 2000. Implications of subdivision proposal near an important shorebird breeding site. *Conservation Advisory Science Notes 274.***

Focus:
Shorebird breeding disturbance
Natural Asset:
New Zealand fairy tern, New Zealand dotterel and variable oystercatcher at Waipua spit NZ
Classification:
Wildlife
Activity:
Beach activities general, walking etc.

Impact:
Indirect impacts of egg exposure, chilling, abandonment, predation
Indicator:
Population dynamics, number of visitors

85. Platteeuw, M.; Henkens, R.J.H.G. 1997a. Possible impacts of disturbance to waterbirds: individuals, carrying capacity and populations. *Wildfowl 48:* 225-236.

Focus:
Waterbirds and recreation
Natural Asset:
Lake Ijsselmeer waterbirds, The Netherlands
Classification:
Wildlife (birds-freshwater)
Activity:
General including boating (sailing, canoeing, windsurfing), beach activities general, swimming
Impact:
Re-allocation of preferred roosts/foraging grounds. Altered energy expenditure.
Indicator:
modelling/mapping recreation-bird interrelationships, bird disturbances, changes to bird behaviour/roosts/foraging grounds, recommend GIS

86. Platteeuw, M.; Henkens, R.J.H.G. 1997b. Waterbirds and aquatic recreation at Lake Ijsselmeer, The Netherlands: the potential for conflict. *Wildfowl 48:* 210-224.

Focus:
Impacts of disturbance to waterbirds
Natural Asset:
Lake Ijsselmeer waterbirds, The Netherlands
Classification:
Wildlife (birds-freshwater)
Activity:
Beach activities general including boating (sailing, speedboats, jetskis, windsurfers), fishing, swimmers
Impact:
Lowered carrying capacity
Extra energy expenditure = increased feeding, longer or more efficient foraging.
Disturbance to foraging, increased adult mortality, emigration, decreased reproduction, population.
Indicator:
Changes in energy expenditure, population decline, bird behaviour to disturbances
Recommend GIS to collate info on: temporal/spatial use, food availability, roosting sites; frequency, density and timing of disturbances; vulnerability of birds, variations in responses.

87. **Pomerantz, G.A., Decker, D.J., Goff, G.R. and Purdy, K.G. 1988. Assessing impact of recreation on wildlife: a classification system.** ***Wildlife Society Bulletin 16:*** **58-62.**

Focus:
Impact of recreation on wildlife a classification scheme
Natural Asset:
General wildlife
Classification:
Wildlife
Activity:
General
Impact:
Impacts classified as: direct mortality; indirect mortality; lowered productivity; reduced use of refuge; reduced use of preferred habitat on refuge; aberrant behaviour or stress
Indicator:
None

88. **Ream, C.H. 1976. Loon productivity, human disturbance, and pesticide residues in northern Minnesota.** ***Wilson Bulletin 888(3):427-432***

Focus:
Effects of canoeists and camping on common loon
Natural Asset:
Freshwater common loon
Classification:
Wildlife
Activity:
Boating (canoeing, kayaking), camping, water recreation
Impact:
Decreased in loon productivity
Indicator:
Breeding and fledgling success

89. **Reeves, R., 1992. Whale Responses to Anthropogenic Sounds: A Literature Review.** ***Science and Research Series 47.***

Focus:
Review of monitoring reports on impacts of noise disturbance on cetaceans.
Natural Asset:
Wildlife, whales, marine ecosystem
Classification:
Wildlife, (marine/coastal)
Activity:
Wildlife viewing (whale watching, activities other than tourism ie. industry, shipping).

Impact:
Behavioural; response such as, diving or surfacing, pod scattering, changing course, 'flinching' possibly attributing to over exertion, foraging and calf rearing disturbance.
Indicator:
Changes in: abundance, distribution, behaviour, physiology, management activities (regulations/permits), educative value of whale watching experience

90. Reijnen, R., Foppen, R., Braak, C.T. and Thissen, J. 1995. The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads. ***Journal of Applied Ecology 31:187-202.***

Focus:
Effects of traffic on breeding bird populations
Natural Asset:
43 bird species, Netherlands
Classification:
Wildlife
Activity:
Land vehicle use
Impact:
Increased noise, visual stimuli, reduced breeding density
Indicator:
Breeding density, density of traffic, noise of traffic, visual impact of traffic

91. Reijnen, R. and Foppen, R. 1994. The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warblers (*Phylloscopus trochilus*) breeding close to a highway. ***Journal of Applied Ecology 31:85-94.***

and

Reijnen, R. and Foppen, R. 1994. The effects of car traffic on breeding bird populations in woodland. II. Breeding dispersal of male willow warblers (*Phylloscopus trochilus*) in relation to the proximity of a highway. ***Journal of Applied Ecology 31:95-101.***

Focus:
Effects of traffic on breeding birds
Natural Asset:
Bird populations, willow warbler *Phylloscopus trochilus*
Classification:
Wildlife
Activity:
Land vehicle use
Impact:
Displacement of population further from highway where habitat more substantial and better quality, noise disturbance, decreased mating success in sub-optimal

habitat, collisions resulting in death, air pollution causing reduced numbers of insects (food), visual stimuli causing disturbance

Indicator:

Change in abundance, demographics and distribution of birds, timing of returns to breeding area

92. **Rich, J.W. 1991.** ***Management strategies for the riparian zones of the Manganuioteao River.*** **Unpublished MApplSc Thesis, Lincoln University.**

Focus:

Recreational impacts on riparian zones

Natural Asset:

Riparian zone of the Manganuioteao River, New Zealand

Classification:

Vegetation, Wildlife (Blue Duck and Trout)

Activity:

Fishing, camping, swimming, picnicking, boating (rafting, canoeing, kayaking), tubing,

Impact:

Vandalism, increased fire risk/careless use of fire, wildlife disturbance and population decline

Indicator:

Changes in wildlife population, occurrence of fire/vandalism

93. **Robertson, C.J.R. 1994.** ***Development of the Royal Albatross Colony and Increasing Tourist Activity at Taiaroa Head, New Zealand.*** **DOC, Wellington.**

Focus:

Royal Albatross

Natural Asset:

Taiaroa Head

Classification:

Wildlife (Albatross)

Activity:

Viewing

Impact:

Changes to bird behaviour

Indicator:

Chicks born in view/out of view, movement of chicks

94. **Robertson, C.J.R., 1992. Effects of Nature Tourism on Marine Wildlife** ***in Marine Conservation and Wildlife Protection Conference Proceedings;*** **New Zealand Conservation Authority** ***Te Whakahaere Matua Atawhai o Aotearoa*****; Wellington**

Focus:

Effects of nature tourism on marine wildlife

Natural Asset:
Wildlife; albatross, gannet
Classification:
Wildlife
Activity:
Wildlife viewing
Impact:
Poorer breeding success through disturbance during vulnerable seasons. Habituation. Displacement. Reduction of habitat availability.
Indicator:
Management actions, displacement, breeding success, visitor numbers

95. Safina, C. and Burger, J. 1983. Effects of human disturbance on reproductive success in the Black Skimmer. Condor 85: 164-171.

Focus:
Effects of human disturbance on the reproductive success of the Black Skimmer
Natural Asset:
Black Skimmers (*Rynchops niger*) Long Island, New York
Classification:
Wildlife (birds- Black Skimmer)
Activity:
Wildlife viewing
Impact:
Nest and colony desertion, decreased nesting and fledgling success, increased density of non-disturbed areas
Indicator:
Changes in breeding success, population size, number of nests

96. Scheffer, V.B. 1974. *A Voice for Wildlife* Charles Scribner's Sons; New York.

Focus:
Impact of consumptive activities on wildlife
Natural Asset:
Wildlife in natural areas
Classification:
Wildlife
Activity:
Hunting
Impact:
Decreased populations, disturbance to other wildlife, no-target deaths/injuries, constricted distribution, behavioural changes, species composition change
Indicator:
changes in target and non-target species composition, abundance, diversity, distribution
nature of activity

97. Schmidt, F.C. 1966. The status of osprey in Cape May County, New Jersey between 1939 and 1963. *Chesapeake Science 7:220-223*

Focus:
Effects of human disturbance on osprey, New Jersey USA
Natural Asset:
Osprey
Classification:
Wildlife
Activity:
Fishing, wildlife viewing, boating
Impact:
Disturbance general, diminishing food supply, habitat destruction, pollution in the food chain
Indicator:
Changes in abundance/breeding/nesting/fledgling success, displacement, evidence of environmental pollutants in food chain, vegetation damage

98. Servheen, C.W. 1975. *Ecology of the wintering bald eagles on the Skagit River*, Washington. University; Seattle

Focus:
Ecology of wintering bald eagles, Washington State
Natural Asset:
Bald eagles, Washington State
Classification:
Wildlife
Activity:
Fishing, biking, walking, wildlife viewing, boating
Impact:
Disturbance general, displacement, habitat destruction
Indicator:
Displacement, changes in behaviour, nature of activities of visitors

99. Shay, D.S. 1973. *A management-oriented study of bald eagle concentrations in Glacier National Park.* University of Montana; USA

Focus:
Visitor impacts on bald eagle, National Glacier Park
Natural Asset:
Bald eagle, National Glacier Park
Classification:
Wildlife
Activity:
Wildlife viewing
Impact:
Disturbance, general
Indicator:
Behavioural changes

100. Simonds, M.A. 1991. Dolphins and Ecotourism: Determining Impacts. Pp. 662-676 in Kusler, J.A. (Ed) *Ecotourism and Resource Conservation, Vol 2.* Madison: Ecotourism and Resource Conservation Project.

Focus:
Impacts of ecotourism on Dolphins
Natural Asset:
N. American dolphin populations
Classification:
Wildlife (mammals- dolphins)
Activity:
Swimming, wildlife viewing, boating, swim-with-wildlife
Impact:
Behavioural change (eg anti-social, withdrawn, loss of interest), disturbance of dolphin communities, disruption of natural behaviours,
Indicator:
Changes in dolphin behaviour

101. Slooten, E.; Dawson, S.M. 1995. Conservation of marine mammals in New Zealand. *Pacific Conservation Biology 2:* 64-76.

Focus:
Threats to NZ marine mammals
Natural Asset:
Marine mammals
Classification:
Wildlife (mammals, marine)
Activity:
Wildlife viewing (whale/dolphin watching, boating, aircraft related activities (fixed wing and helicopter viewing)
'Swim with' attractions (dolphins, seals)
Impact:
Disturbance to mammal's behaviour
Indicator:
Whales- vocal patterns, blow intervals, diving mannerisms
Dolphins- behaviour with boats compared with no boats

102. Smith, D., Hughey, K., Booth, K. 1997. *Impacts of Recreational Users on the Wildlife of Braided Rivers – a Preliminary Study of the Tekapo River.* Draft report, Lincoln University, New Zealand.

Focus:
Fish (Trout)
Natural Asset:
Tekapo River Braided
Classification:
Wildlife (Birdlife on braided river)
Activity:
Fishing –(also vehicles and walking)

Impact:
Disturbance of birdlife/breeding
Indicator:
Flight of birds, alarm display of birds, nest destruction

103. Stalmaster, M.V. 1976. Winter ecology and effects of human activity on bald eagles in the Nooksack River Valley, Washington. West Washington University; Bellingham

Focus:
Effects of human activity on bald eagles
Natural Asset:
Bald eagle, Washington
Classification:
Wildlife
Activity:
Wildlife viewing, boating, shore and river fishing
Impact:
Disturbance, general
Indicator:
Changes in behaviour

104. Stalmaster, M.V. and Newman, J.R. 1978. Behavioural response of wintering bald eagles to human activity. ***Journal of Wildlife Management 42(3):506-513.***

Focus:
Behavioural responses of wintering bald eagles to human activities
Natural Asset:
Bald eagles, Washington State
Classification:
Wildlife
Activity:
Boating, wildlife viewing, fishing
Impact:
Disturbance, displacement
Indicator:
Changes in behaviour, displacement, nature of activity in relation to behavioural change

105. Stebbins, R.C. 1974. Off-road vehicles and fragile desert. ***American Biol.Teach. 36(4):203-208, 220 and 36(5):294-304.***

Focus:
Off-road vehicle damage to flora/fauna in desert environments
Natural Asset:
Desert environments
Classification:
Wildlife, Vegetation

Activity:
Land vehicle use (Off-road)
Impact:
Injury and death of ground nesting birds, lizards and snakes; collapse of burrows, soil compaction, depletion of forage and vandalism (desert tortoise)
Indicator:
Change in species composition, abundance, diversity, distribution, death/injury to species, soil compaction, distribution and number of off-road vehicles

106. Steidi, R.J. and Robert, A. 1996. Responses of Bald Eagles to Human Activity During the Summer in Interior Alaska. ***Ecological Applications 6(2): 482-491***

Focus:
Human disturbance on Bald Eagle populations
Natural Asset:
Bald Eagle, Wildlife, avian fauna
Classification:
Wildlife
Activity:
Boating (rafting)
Impact:
'Flushing' (taking flight) response of birds, particularly non-breeding adults, possible impact of increased exertion, displacement, future breeding changes
Indicator:
Flush distance, flush response

107. Steiner, A.J.; Leatherman, S.P. 1981. Recreational impacts on the distribution of ghost crabs ***Ocypode quadrata*** **Fab.** ***Biological Conservation 20:*** **111-122.**

Focus:
Impacts of various recreational activities on Ghost Crabs *Ocypode quadrata*
Natural Asset:
Ghost Crabs *Ocypode quadrata,*
Assateague Island, Maryland-Virginia, USA
Classification:
Wildlife (marine/coastal)
Activity:
Walking, land vehicle use (ORV)
Impact:
ORVs-Crushing/burying crabs in burrows, interrupting reproductive cycle, modifying beach habitat to one that can not support crab population. Overall result = decreased population of ghost crabs
Pedestrians- increased crab population densities with food scraps
Indicator:
Ghost crabs selected as an indicator species for examining the detrimental effects of recreation beach use.
Crab population densities, life-expectancy, burrow distribution

108. Steinhart, P. 1978. Off we go, into the wild green yonder. ***National Wildlife 16(4):16-19.***

Focus:
Effects of aircraft on wildlife (seal, wolves, bird species)
Natural Asset:
Seals, wolves, bison, waterfowl, condor etc.
Classification:
Wildlife
Activity:
Aircraft related viewing, landings
Impact:
Behavioural changes in species
Indicator:
Behavioural change, altitude and type of craft

109. Sutton, S., Devlin, P., Simmons, D. 1993. Kapiti Island, a Natural Area in Demand : Assessing Social Impacts; ***Geo Journal 29.3:*** **253-262.**

Focus:
Natural experience
Natural Asset:
Native reserve (Kapiti Island)
Classification:
Wildlife (native birdlife), Vegetation (regenerating forest)
Activity:
Viewing
Impact:
Social impact
Indicator:
LAC

110. Sutton, S.T. 1992. Kapiti Island: a case study in social impact assessment: setting the limits. Unpublished MApplSc Thesis, Lincoln University, New Zealand.

Focus:
Limits of Acceptable Change: social carrying capacity for natural areas
Natural Asset:
Kapiti Island
Classification:
Wildlife (in nature reserve and marine reserve)
Activity:
Viewing (bird watching), walking, boating
Impact:
Social impact: Experiential conditions eg crowding, interference, sharing limited facilities
Indicator:
Expectations (pre/post-trip); motivations (pre/post-trip); dis/satisfaction; visitor type

111. Swenson, J.E. 1975. *Ecology of the bald eagle and osprey in Yellowstone National Park.* Montana State University; Bozeman

Focus:
Effects of human activities on bald eagle and osprey
Natural Asset:
Bald eagle, osprey USA
Classification:
Wildlife
Activity:
Fishing, wildlife viewing, boating
Impact:
Disturbance, displacement, decreased reproduction
Indicator:
Changes in behaviour, displacement, population dynamics in the presence of change

112. Thomson, R.B. 1977. Effects of human disturbance on an Adelie Penguin rookery and measures of control. In Smithsonian Institution *Adaptations Within Antarctic Ecosystems.* Houston: Gulf.

Focus:
Human disturbance on an Adelie Penguin rookery
Natural Asset:
Cape Royds Adelie Penguin rookery, Antarctica
Classification:
Wildlife (bird- Adelie Penguins)
Activity:
Wildlife viewing
Impact:
Helicopter visits resulted in bird dispersal, breeding disturbance, egg and chick exposure to predation by Skuas, unsettling young non-breeding birds
Indicator:
Changes in the rookery population

113. Titus, J.R. and VanDruff, L.W. 1981. Response of the Common Loon to recreational pressure in the Boundary Waters Canoe Area, Northeastern Minnesota. *Wildlife Monographs No. 79.*

Focus:
Response of the Common Loon to recreational pressure
Natural Asset:
Common Loons, Boundary Waters Canoe Area, NE Minnesota.
Classification:
Wildlife (birds-Common Loons)
Activity:
General including boating (canoeing, kayaking), camping, fishing, swimming,
Impact:
Decreased breeding and fledgling success, decreased egg numbers, habituation

Indicator:
Changes in nesting success, brood rearing success, population levels

114. Tremblay, J. and Ellison, L.N. 1979. Effects of human disturbance on breeding of Black-crowned Night Herons. *The Auk 96:* 364-369.

Focus:
Effects of human disturbance on breeding of Black-crowned Night Herons
Natural Asset:
Black-crowned Night Herons, Quebec, Canada
Classification:
Wildlife (birds- Black-crowned Night Herons)
Activity:
Wildlife viewing
Impact:
Inhibiting laying, nest abandonment, increased risk of egg predation, increased nestling mortality, discourages settlement
Indicator:
Changes in the number of empty nests, population size, breeding success

115. Tuite, C.H., Owen, M. and Paynter, D. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. *Wildfowl 34:* 48-63.

Focus:
Impacts of recreation on wildfowl
Natural Asset:
Wildfowl at Llangorse Lake and Talybont Reservoir, South Wales
Classification:
Wildlife (birds-wildfowl)
Activity:
Boating (sailing, windsurfing, power, water-skiing, rowing, canoeing), fishing, walking, picnicking
Impact:
Habitat displacement, disturbance of feeding, breeding, increased energy expenditure, reduction in habitat carrying capacity
Indicator:
Changes in population

116. Van Den Akker, J.B. 1960. Human encroachment on bighorn habitat. In *Desert Bighorn Council Transactions 3:* 38-40.

Focus:
Human encroachment on bighorn habitat
Natural Asset:
Bighorn sheep
Classification:
Wildlife (mountain sheep)

Activity:
Walking, land vehicle use (off road), camping, hunting
Impact:
Harassment, habitat displacement, fleeing, behavioural change, habituation, introduction of pests/competing wildlife
Indicator:
Population change

117. Van Der Merwe, D. and Van Der Merwe, D. 1991. Effects of off-road vehicles on the macrofauna of a sandy beach. ***South African Journal of Science 87:*** **210-213.**

Focus:
Effects of off-road vehicles on sandy beach macrofauna
Natural Asset:
Macrofauna on South African sandy beaches
Classification:
Wildlife (macrofauna)
Activity:
Land vehicle use (ORVs/4-wheeldriving, vehicle access to attractions)
Impact:
Crushing of macrofauna, also discusses physical impacts (erosion) and other wildlife impacts (disturbance, habitat alteration, increased predation)
Indicator:
Change in percent/number of animals damaged by vehicle traffic

118. Villouta, E. 2000. Potential ecological impacts of harvesting kina (*Evechinus chloroticus*) in Fiordland. ***Conservation Advisory Science Notes 286.***

Focus:
Ecological impacts of harvesting kina in Fiordland
Natural Asset:
Kina *Evechinus chloroticus* in Fiordland
Classification:
Wildlife
Activity:
Fishing (shellfish collection/harvest)
Impact:
Dramatic change in species composition/community structure through removal of kina, allowing large algal habitat-forming species to form a more homogenous tall canopy. Loss of mid-zone habitat due to species composition changes.
Indicator:
Species composition, community structure, number of kina

119. Wallmo, O.C. 1975. Important Game Animals and Related Recreation in Arid Shrublands of the United States. Rocky Mountain Forest and Range Experiment Station; Colorado, USA

Focus:
Recreation effects on game animals
Natural Asset:
Arid shrublands, USA
Classification:
Wildlife
Activity:
Wildlife viewing; hunting
Impact:
Wildlife disturbance; loss
Indicator:
None specified

120. Walls, G. 1999. Visitor impacts on freshwater avifauna in New Zealand. *Conservation Advisory Science Notes No. 240,* Department of Conservation, Wellington.

Focus:
Visitor impacts on wetlands lit review and NZ case studies
Natural Asset:
NZ wetland habitats and birds
Classification:
Wildlife (birds, freshwater/wetlands)
Activity:
Hunting, fishing, water sports general, land vehicle use (off-road), aircraft related activities, camping, picnicking, horse trekking, walking, sightseeing
Impact:
Noise- many problems associated with vehicle and boat usage, disturbance of bird life, breeding and habitats, crushing/trampling, introduction of weeds and pests
Indicator:
Recommended indicators: disturbance of wetland soil/vegetation, bird breeding/ habitat/behavioural changes, weed/pest spread

121. Ward, J.C.; Stewart, I.D. 1989. *An approach to lake management: ecology, values and conflict at Lake Alexandrina.* Centre for Resource Management.

Focus:
Lake management with respect to ecology, use and values
Natural Asset:
Lake Alexandrina, South Canterbury, NZ
Classification:
Physical, Vegetation, Wildlife
Activity:
Fishing, walking, swimming, boating, camping

Impact:
Modification of stream bed/margins and trees for recreation purposes, sewage/ nutrient discharge from nearby huts, campsites and accommodation, disturbance of fish and birds
Indicator:
Effects of human action on birds, displacement of birds by people, seasonal disturbance of birds, breeding success of grebes

122. Watson, J.J, Kerley, G.I.H and McLachlan, A. 1996. Human activity and potential impacts on dune breeding birds in the Alexandria Coastal Dunefield. ***Landscape and Urban Planning 34: 315-322***

Focus:
Human impacts on dune feeding breeding birds
Natural Asset:
Dune feeding birds, South Africa
Classification:
Wildlife, Physical
Activity:
Land vehicle use (Off-road), fishing, walking
Impact:
Damage to archaeological sites, dune morphology, vegetation and fauna. Flushing of birds from nests leading to egg exposure, loss, nest abandonment. Direct destruction of nests and chicks by vehicles. Reduced feeding and brooding.
Indicator:
Vehicle activity, angler and visitor activity, level of management, nesting activity and biology

123. Windsor, J. 1975. ***The response of peregrine falcons (Falco peregrinus) to aircraft and human disturbance.*** **Canadian Wildlife Service Edmonton; Canada**

Focus:
Effects of hikers and aircraft on peregrine falcons
Natural Asset:
Peregrine falcons
Classification:
Wildlife
Activity:
Aircraft over-flights, walking
Impact:
Falcon can dislodge eggs and young from nests when suddenly flushed by people, aircraft or predators.
Indicator:
Falcon behaviour, evidence of dislodged eggs/chicks, altitude of craft, distance of tracks

124. **Wolcott, T.G. and Wolcott, D.L. 1984. Impact of off-road vehicles on macroinvertebrates of a Mid-Atlantic beach.** ***Biological Conservation 29:*** **217-240.**

Focus:
Impact of ORVs on macro invertebrates
Natural Asset:
Macro invertebrates at Cape Lookout National Seashore, North Carolina, USA
Classification:
Wildlife (macro invertebrates – crabs)
Activity:
Land vehicle use (ORVs, 4Wdriving)
Impact:
Crushing and killing,
Indicator:
Changes in total population size, average crab size, population change

125. **Wright, M. 1998. Ecotourism on Otago Peninsula: preliminary studies of yellow-eyed penguin (*Megadyptes antipodes*) and Hooker's sea lion (*Phocartos hookeri*).** ***Science for Conservation 68.***

Focus:
Ecotourism impacts on Yellow eyed penguin and Hooker's sea lion
Natural Asset:
Yellow eyed penguin and Hooker's sea lion, Otago Peninsula, NZ
Classification:
Wildlife
Activity:
Wildlife (bird) viewing
Impact:
Penguins: First time breeders more vulnerable, possible displacement, over exertion.
Hookers sea lions: no disturbance recorded however only two persons approaching mammals, increased numbers of 'approachers' possible impact.
Indicator:
Landing patterns of penguins, foraging time and distance of penguins, reproductive success, number and frequency of sea lions, aggressive behaviours

126. **Yanes, M., Velasco, J.M. and Suarez. 1995. Permeability of roads and railways to vertebrates: the importance of culverts.** ***Biological Conservation 71:217-222.***

Focus:
Permeability of roads and railways to vertebrates
Natural Asset:
Vertebrate populations
Classification:
Wildlife
Activity:
Land vehicle use (traffic, transport corridors)

Impact:
Habitat fragmentation/loss
Indicator:
Movement/isolation of wildlife, size/characteristics of culverts

127. **Zabinski, Catherine A. and Gannon, James E. 1997. Effects of Recreational Impacts on Soil Microbial Communities** ***Environmental Management 21:233-238***

Focus:
Impacts f recreation on soil microbial communities
Natural Asset:
Subalpine campsites
Classification:
Wildlife
Activity:
Camping, walking
Impact:
Decreased percent of total carbon sources utilised (material unable to be metabolised in disturbed sites)
Indicator:
Structure and function of the microbial community in campsite soils relative to undisturbed riparian sites

128. **Zakai D., Levy O. and Chadwick-Furman, N.E. 2000 Experimental fragmentation reduces sexual reproductive output by the reef-building coral** ***Pocillopora damicornis Environmental Management 19(2):185-188***

Focus:
Biophysical and anthropogenic impacts on coral formations
Natural Asset:
Marine ecosystems, coral reefs
Classification:
Wildlife, Vegetation, Physical
Activity:
Water sports general (diving, snorkelling), boating (including jet skiing)
Impact:
Even partial fragmentation of *P. damicornis* colonies (<25% of tissue removed) decreased their larval output by reducing reproductive tissue volume.
Indicator:
Reproductive activity changes from control to damage sites, % reproductive tissue in relation to productivity

2.2 Vegetation

129. Amor, R.L., Stevens, P.L. 1975. Spread of weeds from a roadside into sclerophyll forests at Dartmouth, Australia. ***Weed Research*** **16: 111-118.**

Focus:
Spread of weeds from a roadside into sclerophyll forests
Natural Asset:
Sclerophyll forests, Dartmouth, Australia
Classification:
Vegetation
Activity:
Land vehicle use (road provision/access to tourist attractions)
Impact:
Weed spread, loss of endemic ecosystems (habitat loss)
Indicator:
Changes in frequency of weeds/exotic (introduced) species

130. Arkwright, S.R. 1984. ***The Turoa skifield development and impact.*** **M.Sc. Thesis, Department of Geography, University of Canterbury, New Zealand.**

Focus:
Turoa ski-field impacts
Natural Asset:
Turoa Ski-field, NZ
Classification:
Vegetation, Physical
Activity:
Skiing, ski-field development
Impact:
Loss of ground cover, change in spp. composition, lower reproduction rates,
Indicator:
Loss or change in ground cover, spp. composition, reproduction rates

131. Baiderin, V.V. 1980. Experimental modelling of ecological consequences of winter recreations. ***Soviet Journal of Ecology*** ***11***(3)**: 140-146.**

Focus:
Ecological impacts of winter recreation
Natural Asset:
General- snow covered environments
Classification:
Vegetation, Physical
Activity:
Skiing

Impact:
Snow compaction leading to: increased soil thawing time, decreased soil temperature, increased depth of frozen soil, late blooming of vegetation, vegetation composition/location change
Indicator:
Change in snow compaction, soil temperature characteristics, vegetation quantity and distribution

132. Baiderin, V.V. 1983. Winter recreation and subnival plant development. Soviet Journal of Ecology 13(5): 287-291.

Focus:
Ecological impacts of skiing
Natural Asset:
Snow covered environments and ski-fields
Classification:
Vegetation, Physical
Activity:
Skiing
Impact:
Snow compaction and redistribution of snowpack resulting in: soil erosion, vegetation change
Indicator:
Change in snow compaction, soil temperature characteristics, vegetation quantity and distribution

133. Bayfield, N.G. 1971. Some effects of walking and skiing on vegetation at Cairngorm. In Duffy, E., Watt, A.S. (Eds), *The scientific management of animal and plant communities for conservation.* 11th Symposium of the British Ecological Society, University of East Anglia, Norwich, England.

Focus:
Effects of walking and skiing on vegetation
Natural Asset:
Vegetation at Cairngorm, Scotland
Classification:
Vegetation
Activity:
Skiing, walking
Impact:
Vegetation loss, erosion
Indicator:
Snow density, vegetation loss, vegetation cover

134. Bayfield, N.G. 1979. Recovery of four montane heath communities on Cairngorm, Scotland. *Biological Conservation* 15: 165-179.

Focus:
Vegetation recovery from trampling

Natural Asset:
Vegetation at Cairngorm, Scotland
Classification:
Vegetation
Activity:
Walking
Impact:
Vegetation loss, change in spp composition, decreased recovery rates, erosion
Indicator:
Vegetation loss, change in spp composition, recovery rates

135. Bayfield, N.G. 1980. Replacement of vegetation on disturbed ground near ski lifts in the Cairngorm Mountains, Scotland. ***Journal of Biogeography 7:*** **259-260.**

Focus:
Replacement of vegetation on ski fields
Natural Asset:
Ski field vegetation in the Cairngorm Mountains, Scotland
Classification:
Vegetation
Activity:
Skiing, walking, land vehicle use (ski-field and road access)
Impact:
Scarring of the landscape, erosion, downslope sediment deposition, vegetation loss, change in vegetation species composition, invasion by colonising vegetation species
Indicator:
Change in percent surface vegetation cover, species composition

136. Bayfield, N., Urguhart, U., Cooper, S. 1981. Susceptibility of Four Species of Cladonia to Disturbance by Trampling in the Cairngarm Mountains, Scotland. ***Journal of Applied Ecology*** **18: 303-310.**

Focus:
Various
Natural Asset:
Mountain range
Classification:
Vegetation/Physical
Activity:
Skiing, Walking,
Impact:
Lichen degradation
Indicator:
Lichen degradation,

137. Bell, K.L. and Bliss, L.C. 1973. Alpine disturbance studies: Olympic National Park, USA. *Biological Conservation 5:* 25-32.

Focus:
Alpine disturbance studies:
Natural Asset:
Alpine vegetation, Olympic National Park, USA.
Classification:
Vegetation (alpine)
Activity:
Walking, land vehicle use (road and track development)
Impact:
Loss of vegetation/ground cover, decreased in annual production, change in plant composition, exotic species invasion, erosion,
Indicator:
Changes in vegetation cover, productivity

138. Boorman, L.A.; Fuller, R.M. 1977. Studies on the impact of paths on the dune vegetation at Winterton, Norfolk, England. *Biological Conservation.* 12: 203-216.

Focus:
Impacts of paths on dune vegetation
Natural Asset:
Dune vegetation Norfolk, England
Classification:
Vegetation (coastal/marine)
Activity:
Walking, access to other activities
Impact:
Trampling of vegetation, litter,
Indicator:
Vegetation height/coverage, path occurrence, aerial photo changes

139. Brodhead, J.M.; Godfrey, P.J. 1977. Off-road vehicle impact in Cape Cod National Seashore: disruption and recovery of dune vegetation. *International Journal of Biometeorology 21 (3):* 299-306.

Focus:
ORV's and disruption/recovery of dune vegetation
Natural Asset:
Cape Cod National Seashore, Massachusetts
Classification:
Vegetation - (and Physical marine/coastal)
Activity:
Land vehicle use (ORVs)
Impact:
Decline in beach grass biomass and productivity (vegetation loss)
Indicator:
Changes of continuous grass cover, change in biomass

140. Brothers, T.S., Spingarn, A. 1992. Forest fragmentation and alien plant invasion of central Indiana old-growth forests. *Conservation Biology* 6: 91-100.

Focus:
Forest fragmentation and exotic species invasion
Natural Asset:
Old growth forests in central Indiana
Classification:
Vegetation
Activity:
Walking, land vehicle use, general tourism in forest environments
Impact:
Weed/plant pest introduction, forest fragmentation
Indicator:
Presence of introduced spp, introduced spp richness, various weed indicator spp

141. Clayton, T.O. 1990. *Impacts of use of walking tracks in Tongariro National Park, New Zealand.* Unpublished MSc thesis, University of Auckland.

Focus:
Impact of walking tracks
Natural Asset:
Walking tracks in Tongariro National Park, New Zealand
Classification:
Vegetation, Physical
Activity:
Walking
Impact:
Trampling of soils and vegetation resulting in vegetation loss/height/diversity, soil infiltration/organic matter, also litter
Indicator:
Change in vegetation percent cover, species, species composition, vegetation height, soil colour, soil infiltration, organic matter, percent fines

142. Cole, D.N. 1983. Monitoring the Condition of Wilderness Campsites. Research Paper INT-302. U.S.D.A. Forest Service. Intermountain Forest and Range Experiment Station.

Focus:
Monitoring the condition of wilderness campsites
Natural Asset:
Wilderness and backcountry areas in the USA
Classification:
Vegetation, Physical
Activity:
Camping, walking
Impact:
Damage to trees/vegetation, exposure of soil and tree roots, litter, human waste, loss of vegetation (ground cover)

Indicator:
Previous use impact assessment (visual and measured- litter, vegetation damage, exposed soil, erosion), photos, summary ratings (for individual elements- litter, vegetation damage, etc), LAC

143. Cole, D.N. 1995. Experimental trampling of vegetation. I. Relationship between trampling intensity and vegetation response. *Journal of Applied Ecology 32:* 203-214.

Focus:
Trampling intensity and vegetation response
Natural Asset:
Vegetation in USA mountain regions
Classification:
Vegetation
Activity:
Walking, camping
Impact:
Vegetation loss
Indicator:
Number of passes

144. Cole, D.N. 1995. Experimental trampling of vegetation. II. Predictors of resistance and resilience. *Journal of Applied Ecology 32:* 215-224.

Focus:
Trampling intensity and predictors of vegetation resilience and resistance
Natural Asset:
Vegetation in USA mountain regions
Classification:
Vegetation
Activity:
Walking, camping
Impact:
Loss of vegetation cover
Indicator:
Plant characteristics used as predictors of resilience and resistance

145. Cole, D.N., Bayfield, N.G. 1993. Recreational trampling of vegetation: standard experimental procedures. *Biological Conservation* 63: 209-215.

Focus:
Monitoring trampling impacts on vegetation
Natural Asset:
General
Classification:
Vegetation, Physical

Activity:
Walking
Impact:
Loss of vegetation cover/height, change spp composition, increased bare ground
Indicator:
Changes in vegetation cover, vegetation height, bare ground cover, and cover of individual spp

146. Crawford, A.K and Liddle, M.J. 1977 The effect of trampling on neutral grassland. Biological Conservation 12:135-142

Focus:
Trampling on neutral grassland
Natural Asset:
Soils and vegetation on bank of the R. Thames, England
Classification:
Vegetation, Physical
Activity:
Walking, access to other activities
Impact:
Trampling of vegetation
Indicator:
Human presence, soil density, soil water content, soil penetration resistance

147. Dale, D and Weaver, T. 1974. Trampling effects on vegetation of the trail corridors of north rocky mountain forests. ***Journal of Applied Ecology 11:767-772***

Focus:
Trampling effects on vegetation of the trail corridors of Rocky Mountain Forests
Natural Asset:
Vegetation in natural areas
Classification:
Vegetation
Activity:
Walking, horse trekking
Impact:
Vegetation loss/species composition change, edge effects of trail corridors ie increased light, rainfall changing successional nature of vegetation community, widening of trails, soil compaction, introduction of weeds
Indicator:
Trail width, vegetation changes/damage, soil compaction

148. Emers, M., Jorgensen, J.C., Raynolds, M.K. 1995. Response of arctic tundra plant communities to winter vehicle disturbance. ***Canadian Journal of Botany*** **73: 905-917.**

Focus:
Impacts of winter vehicles on arctic tundra plant communities

Natural Asset:
Arctic tundra plant communities
Classification:
Vegetation
Activity:
Land vehicle use (snowmobiles, ski-field activities)
Impact:
Vegetation loss, spp composition change
Indicator:
Vegetation loss, change in vegetation cover, change in spp composition, increased in bare ground

149. Felix, N.A., Raynolds, M.K. 1989. The effects of winter seismic trails on tundra vegetation in NE Alaska, USA. ***Arctic and Alpine Research*** **21(2): 188-202.**

Focus:
Effects of vehicles on tundra vegetation
Natural Asset:
Tundra vegetation in NE Alaska, USA
Classification:
Vegetation
Activity:
Land vehicle use (ie. access to attractions eg ski-fields)
Impact:
Loss of plant cover, decreased recovery rates, erosion
Indicator:
Change in plant cover, recovery rates, percent bare ground

150. Forbes, B.C. 1992. Tundra disturbance studies. I: long term effects of vehicles on species richness and biomass. ***Environmental Conservation 19(1):*** **48-58.**

Focus:
Long term effects of vehicles on tundra vegetation
Natural Asset:
General tundra vegetation
Classification:
Vegetation
Activity:
Land vehicle use (ie. access to attractions eg ski-fields)
Impact:
Decreased spp richness, reduced biomass, reduced seedling re-establishment
Indicator:
Changes in spp composition/biomass/richness, seedling re-establishment

151. **Foreman, C.L., Ryerson, D.K., Walejko, R.N., Pendleton, J.W. 1976. Effect of snowmobile traffic on Bluegrass (*Poa pratensis*). *Journal of Environmental Quality* 5(2): 129-130.**

Focus:
Effect of snowmobile traffic on Bluegrass (*Poa pratensis*)
Natural Asset:
Bluegrass (*Poa pratensis*)
Classification:
Vegetation
Activity:
Land vehicle use (snowmobile use, ski-field services)
Impact:
Slower spring growth, decreased soil temperatures
Indicator:
Change in vegetation cover/height/spring growth rates

152. **Grabherr, G. 1982. The impact of trampling by tourists on a high altitude grassland in the Tyrolean Alps, Austria. *Vegetatio* 48: 209-217.**

Focus:
Impact of tourist trampling on high altitude grassland
Natural Asset:
Grassland in the Tyrolean Alps, Austria
Classification:
Vegetation
Activity:
Walking
Impact:
Decreased in sensitive species, increased soil bulk density, decreased recovery rates
Indicator:
Change in frequency of species, vegetation recovery rates, vegetation cover, species composition

153. **Grabherr, G. 1985. Damage to vegetation by recreation in the Austrian and German Alps. pp. 100-111 in Bayfield, N.G., Barrow, G.C. (Eds): The ecological impacts of outdoor recreation on mountain areas in Europe and North America. *Recreational Ecology Research Group Report No.9,* 1985.**

Focus:
Recreational impacts on vegetation in the Austrian and German Alps
Natural Asset:
Vegetation in the Austrian and German Alps
Classification:
Vegetation
Activity:
Walking, skiing, land vehicle use (snow grooming)

Impact:
Changes/decreased in plant growth, species composition, decreased reproduction/ re-colonisation, decreased species diversity, soil loss
Indicator:
Change in plant cover/growth/reproduction rates, species composition, soil loss,

154. Greller, A.M., Goldstein, M., Marcus, L. 1974. Snowmobile impact on three alpine tundra plant communities. ***Environmental Conservation 1(2):*** **101-110.**

Focus:
Snowmobile impact on alpine tundra plant communities
Natural Asset:
Alpine tundra plant communities, Colorado
Classification:
Vegetation (arctic tundra vegetation)
Activity:
Land vehicle use (snowmobiles)
Impact:
Plant damage/death and loss of cover, increased bare soil coverage, decreased lichen coverage, erosion,
Indicator:
Changes in vegetation/lichen/ bare ground cover

155. Hosier, P.E.; Eaton, T.E. 1980. The impact of vehicles on dune and grassland vegetation on a south-eastern North Carolina barrier beach. ***Journal of Applied Ecology 17:*** **173-182.**

Focus:
Vehicles on barrier beach dune and grassland vegetation
Natural Asset:
Barrier beach dune/grassland vegetation, Cape Fear area, North Carolina, USA
Classification:
Vegetation (coastal)
Activity:
Land vehicle use (ORV)
Impact:
Vegetation damage (reduction of plant cover/height, decreased species diversity), alterations to community composition, soil compaction, disturbance to other recreational users (fishers, surfers, sunbathers)
Indicator:
Vegetation cover, distribution, type and height, soil penetration resistance, size distribution of sand particles

156. Hudman, L.E. and Hawkins, D.E. 1989. ***Tourism in contemporary society.*** **New Jersey: Prentice-Hall.**

Focus:
General physical environment

Natural Asset:
General physical environment
Classification:
Vegetation, Wildlife, Physical
Activity:
General including walking, camping, boating, facility development, wildlife viewing, fishing, souveniring,
Impact:
Change species composition for vegetation, increased fire risk, altered plant age structure (few young), litter, vegetation destruction/damage, noise/air/water pollution, habitat loss/displacement, erosion, wildlife mortality/behaviour change
Indicator:
Change in species composition/numbers, increased pollution levels

157. Ives, J.D. 1974. Small-scale examples (4) The impact of man as a biped. Pp. 921-924 in Ives, J.D. and Barry, R.G. (Eds) ***Arctic and Alpine Environments.*** **Harper and Row: New York.**

Focus:
The impact of trampling in alpine environments
Natural Asset:
Alpine/tundra environments
Classification:
Vegetation, Physical
Activity:
Walking, skiing
Impact:
Vegetation damage and death, soil compaction, loss of vegetation cover, erosion,
Indicator:
Change in vegetation cover, erosion, soil horizon exposed

158. Jefferies, B.E. 1982. Sagarmatha National Park: The Impact of Tourism in the Himalayas. ***Ambio 11(5):274-281***

Focus:
Impact of tourism on the Himalayas
Natural Asset:
Sagarmatha National Park
Classification:
Vegetation, Physical
Activity:
Mountaineering, climbing, walking, accommodation, camping
Impact:
Excessive collection of forest and shrub-land for fuel wood, regeneration retardation from taking practices, litter and waste disposal, villages health and livelihood standards
Indicator:
Energy requirements and use by villages and tourists, vegetation/fauna abundance, quality, species composition, water and soil status in catchment areas

159. Johnstone, I.M.; Coffey, B.T.; Howard-williams, C. 1985. The role of recreational boat traffic in interlake dispersal of macrophytes: a New Zealand case study. ***Journal of Environmental Management 20:*** **263-279.**

Focus:
Recreational boat traffic and macrophyte dispersal in NZ lakes
Natural Asset:
NZ North Island lakes
Classification:
Vegetation (macrophytes)
Activity:
Boating, related water activities, fishing
Impact:
Weed dispersal and spread
Indicator:
Presence/absence of weeds in lakes and on boats

160. Keddy, P.A., Spavold, A.J., Keddy, C.J. 1979. Snowmobile impact on old field and marsh vegetation in Nova Scotia, Canada - an experimental study. ***Environmental Management*** **3(5): 409-415.**

Focus:
Snowmobile impacts on old field and marsh vegetation
Natural Asset:
Nova Scotia, Canada
Classification:
Vegetation, Physical
Activity:
Snow related land vehicle use (snow-mobiling, ski-field services)
Impact:
Snow compaction, alteration of soil surface microstructure, decreased suitability for seed germination
Indicator:
Change in snow compaction, vegetation growth

161. Kliskey, A.D. 1992. ***Wilderness perception mapping: a geographic information systems (GIS) approach to the application of wilderness perceptions to protected areas management in New Zealand.*** **Unpublished PhD Thesis, University of Otago, Dunedin, New Zealand.**

Focus:
Wilderness perception mapping, planning, and GIS
Natural Asset:
North West Nelson
Classification:
Vegetation (Protected area system: indigenous scrub, podocarp and beech forest, alpine herbfield)
Activity:
Walking, camping

Impact:
N/A
Indicator:
Wilderness perception mapping

162. Liddle, M.J.; Greig-Smith, P. 1975. A survey of tracks and paths in a sand dune ecosystem. II. Vegetation. *Journal of Applied Ecology 12:* 909-930.

Focus:
Trampling of sand dune vegetation
Natural Asset:
Aberffraw Sand dune system, Anglesey, North Wales
Classification:
Vegetation (coastal)
Activity:
Walking, land vehicle use
Impact:
Destruction of vegetation and subsequent change in composition, reduction in biomass and species numbers but not always diversity
Indicator:
Species occurrence, vegetation damage, soil compaction, presence of dicotyledonous species

163. Liddle, M.J.; Scorgie, H.R.A. 1980. The effects of recreation on freshwater plants and animals: a review. *Biological Conservation 17:* 183-206.

Focus:
Effects of recreation on freshwater plants and animals
Natural Asset:
Freshwater plants and animals (general)
Classification:
Vegetation, Wildlife (freshwater)
Activity:
General- water and shore based activities (boating, angling, swimming)
Impact:
Boat-wash, turbulence, disturbance to animals, pollution, trampling,
Indicator:
Various-damage to vegetation, water pollution levels, sewage presence in water, numbers of vegetation/animal species (e.g macrophyte counts, presence of birds)

164. Liddle, M.J. 1975. A selective review of the ecological effects of human trampling on natural ecosystems. *Biological Conservation 7*: 17-36

Focus:
Trampling on natural ecosystems

Natural Asset:
General
Classification:
Vegetation, Physical, Wildlife
Activity:
Walking
Impact:
Habitat damage, wildlife disturbance, vegetation damage, change in soil water/ nutrients/density
Indicator:
Changes in: soil characteristics, vegetation cover, presence/absence of wildlife/ vegetation species, distribution of people

165. Lonsdale, W.M. and Lane, A.M. 1994. Tourist vehicles as vectors of weed seeds in Kakadu National Park, Northern Australia. ***Biological Conservation 69:*** **277-283.**

Focus:
Tourist vehicles as vectors of weeds
Natural Asset:
Kakadu National Park, Northern Australia
Classification:
Vegetation
Activity:
Land vehicle use
Impact:
Invasion of weeds and exotic plant species
Indicator:
Change in number of weed infestations

166. Luckenbach, R.A.; Bury, R.B. 1983. Effects of off-road vehicles on the biota of the Algodones Dunes, Imperial County, California. ***Journal of Applied Ecology 20:*** **265-286.**

Focus:
ORVs and biota of sand dunes
Natural Asset:
Algodones Dunes, Imperial County, California, USA
Classification:
Vegetation, Wildlife
Activity:
Land vehicle use (ORVs)
Impact:
Loss of vegetation, lizard and mammal species and population from impacted areas,
Compaction, reduced moisture, temperature change in soils
Loss of breeding, feeding, and sheltered areas for wildlife
Indicator:
Individual and species vegetation/wildlife population numbers, evidence of ORV related death/injury

167. **Neugirg, B. 1986. Investigations into the effects of ski pistes on alpine pasture vegetation at Jenner, Upper Bavaria.** ***Zeitschrift fur vegetationstechnik im Landschafts und Sportstattenbau 9(2):46-54.***

Focus:
Impacts of piste on alpine pasture vegetation, Germany
Natural Asset:
Alpine vegetation Bavaria
Classification:
Vegetation
Activity:
Snow related activities, skiing, snowboarding, construction/management
Impact:
Change in species composition, lower abundance
Indicator:
Species composition, abundance, activity

168. **Park, G.N 1971.** ***Possible Disturbance to Forest at Keith George Park Silverstream, by Motorway Extension.*** **Victoria University; Wellington**

Focus:
Motorway extension impact on adjacent forest
Natural Asset:
Keith George Park, Wellington NZ
Classification:
Vegetation
Activity:
Land vehicle use
Impact:
Damage/loss of vegetation, habitat fragmentation and isolation, edge effect of introduced weeds/pests and microclimate change, species composition change, soil change
Indicator:
Change in vegetation/composition/health/abundance/diversity, change in soil

169. **Perrott, Lyon, Timlock and Kesa 1970.** ***A Master Plan for the Tidal River Settlements – Wilson's Promontory National Park.*** **Melborne National Parks Service; Melborne, Australia**

Focus:
Planning for visitor use in natural environments without causing degradation to ecological environment
Natural Asset:
Wilson's Promontary National Park
Classification:
Vegetation, Wildlife
Activity:
Camping, caravanning, accommodation, land vehicle use, walking, wildlife viewing, facilities

Impact:
General inclusive
Indicator:
None specified

170. Pignatti, S. 1993. Impact of tourism on the mountain landscape of central Italy. ***Landscape and Urban Planning 24:49-53.***

Focus:
Impact of tourism on vegetation/landscape, Italy
Natural Asset:
Mountain slopes, ski fields
Classification:
Vegetation
Activity:
Skiing, snowboarding
Impact:
Change in species composition.
Indicator:
Species composition and abundance, tourist activity

171. Racine, C.H.. and Ahlstrand, G.M. 1991. Thaw response of tussock shrub tundra to experimental all-terrain vehicle disturbances in South-central Alaska. ***Arctic 33(1):31-37.***

Focus:
Off road vehicle impacts on tussock lands, Alaska
Natural Asset:
Tussock lands
Classification:
Vegetation
Activity:
Land vehicle use (Off road vehicles)
Impact:
Change in thaw response
Indicator:
Vegetation cover, thaw response, vehicle type, temporal and spatial change in environment

172. Reed, R.A., Johnson-Barnard, J., Baker, W.L. 1996. Contribution of roads to forest fragmentation in the Rocky Mountains. ***Conservation Biology*** **10: 1098-1106.**

Focus:
Contribution of roads to forest fragmentation
Natural Asset:
Medicine Bow-Routt National Forest in SE Wyoming, USA
Classification:
Vegetation, wildlife, physical

Activity:
Land vehicle use (road provision/access to tourist attractions)
Impact:
Loss of forest interior plant species, alteration of shape/attributes etc of forest, disturbance to wildlife habitats/migrational behaviour, climatic changes, decreased soil moisture, increased temperature,
Indicator:
GIS incorporating- number/area/edge influence/perimeter/shape of forest patches; also Shannon-Wiener diversity, dominance, contagion, and contrast

173. **Rickard, W.E., Brown, J. 1974. Effects of vehicles on arctic tundra.** ***Environmental Conservation 1(1): 55-62.***

Focus:
Effects of off road vehicles on arctic tundra
Natural Asset:
Tundra grasslands
Classification:
Vegetation
Activity:
Land vehicle use (Off roading)
Impact:
Destruction of plant cover, breakage of surface organic matt, erosion, increase in thaw depth, peat compaction and increased heat transfer into and out of underlying soil, removal of peat layer causing subsidence of frozen ground as it thaws
Indicator:
Changes in thaw rates, subsidence, vegetation loss and recovery

174. **Rogers, G, and Kimberly, M. 1990.** ***Turoa ski field, Tongariro National Park. Vegetation monitoring programme.*** **Forest Research Institute; Rotorua.**

Focus:
Vegetation on Turoa ski field, NZ
Natural Asset:
Ski field vegetation
Classification:
Vegetation
Activity:
Skiing and related activities
Impact:
Sedimentation of wetland area, change in species composition, decline in total vegetation in certain areas
Indicator:
Change in percent cover in vegetation and bare ground areas, species composition

175. **Sheate, W.R and Taylor, R.M. 1990. The Effect of Motorway Development on Adjacent Woodland.** ***Journal of Environment Management 31:261-267.***

Focus:
Effect of motorway development on adjacent woodland
Natural Asset:
Forest
Classification:
Vegetation
Activity:
Land vehicle use (transport), sight seeing
Impact:
Habitat fragmentation and biogeographical isolation, noise, visual stimuli/intrusion, contamination of vegetation via pollutants, disturbance to community structure and composition, taking land, changes to hydrological flow.
Indicator:
Change in health, quality, attrition of forest, chemical composition of vegetation and soil, species composition

176. **Slatter, R.J. 1978. Ecological effects of trampling on sand dune vegetation.** ***Journal of Biological Education 12*****: 89-96.**

Focus:
Trampling on sand dune vegetation
Natural Asset:
Ecology/vegetation on sand dunes, Ainsdale, Merseyside, England
Classification:
Vegetation, Physical (coastal/marine)
Activity:
Walking (access to activities)
Impact:
Destruction of vegetation species, reduction of dune vegetation height, increased soil compaction, increased/decreased soil moisture, disturbances to competitive balance between species and therefore changes the plant community structure,
Indicator:
Variation of vegetation species, vegetation height, soil compaction

177. **Southerland, M.T. 1995. Conserving biodiversity in highway development projects.** ***The Environmental Professional 17:226-242.***

Focus:
Conserving biodiversity in highway developments
Natural Asset:
Natural areas, landscape general
Classification:
Vegetation, Wildlife
Activity:
Land vehicle use (highway construction, traffic)

Impact:
Loss of biodiversity, direct, indirect and cumulative impacts to habitats, natural areas, landscape etc. Fragmentation of habitat, creation of disturbance corridors, physical disruption of continuos vegetative communities, destruction of functions and structure of habitat, wildlife disturbance/loss, changes in species composition, decrease in habitat for wildlife, disruption of migratory paths
Indicator:
Ecosystem characteristics and changes immediate/indirect/long term/cumulative
Changes in hydrological flows, soil/erosion, species composition, abundance and diversity, chemical properties/pollutants in soils, vegetation and food chain effects on wildlife, habitat connectivity, patch distribution, ecosystem functions (eg. Status of flood storage capacity, energy, nutrient cycling)

178. **Spencer, H.J. and Port, G.R. 1988. Effects of roadside conditions on plants and insects. II soil conditions.** ***Journal of Applied Ecology 25:709-715.***

Focus:
Effects of atmospheric roadside conditions on plants and insects
Natural Asset:
Landscape, roads, adjacent habitat
Classification:
Vegetation, Wildlife
Activity:
Land vehicle use (driving, transport)
Impact:
Higher nitrogen content, higher dry matter weight, increased abundance of aphids adjacent to roadsides.
Indicator:
Species abundance, growth rates, dry weight matter, total nitrogen count

179. **Swain, C. 1992.** ***"Vandals in the Temple": A study of the physical and cultural impacts of rockclimbing in Tongariro National Park – with emphasis on vegetation values:*** **Unpublished Dissertation,. Fitzwilliam College, Cambridge University.**

Focus:
Rock climbing impacts
Natural Asset:
Subalpine plant communities, rock formations and Maori cultural values in Tongariro National Park, New Zealand
Classification:
Vegetation, Physical
Activity:
Climbing
Impact:
Vegetation degradation, soil compaction and erosion, damage to natural features
Indicator:
Changes in bare ground, vegetation height, species numbers and abundance, presence of rock climbing apparatus and 'scrubbed' surfaces

180. **Trakolis, Dimitrios, Platis, Panagiotis and Meliadis Ioannis 2000 Biodiversity and Conservation Actions on Mount Voras, Greece** ***Environmental Management 26:145-151***

Focus:
Preservation and conservation of biodiversity and ecological systems on Mt Voras within the pressures of rural development and tourism
Natural Asset:
Montane flora and fauna
Classification:
Vegetation,Wildlife
Activity:
Sight seeing, wildlife viewing, accommodation
Impact:
General ecological degradation including trampling vegetation, pollution increase, litter, wildlife disturbance
Indicator:
Changes in ecological condition, numbers of tourist and activities

181. **Tyser, R.W. and Worley, C.A. 1992 Alien Flora in Grasslands Adjacent to Road and Trail Corridors in Glacier National Park, Montanat (USA).** ***Conservation Biology 6(2):253-262***

Focus:
Introduced vegetation via road and trail corridors
Natural Asset:
Landscape general, Glacier National Park Montana USA
Classification:
Vegetation
Activity:
Walking, land vehicle use (driving, transport)
Impact:
Transport of introduced/exotic species via vehicle tires/shoes etc; displacement of native species, change in species diversity, community structure, increased vulnerability of native species to invasion by exotic species through other anthropogenic disturbances and livestock grazing
Indicator:
Species diversity, community structure, abundance, introduced species abundance, diversity, species richness

182. **Ward, J.C. and Beanland, R.A. 2000. Interactions Between Tourists and the Natural Environment: Impacts of Tourist Trampling on Geothermal Vegetation and Tourist Experiences at Geothermal Sites in Rotorua.** ***Tourism Research and Education Centre (TREC) Report No 16.*** **Lincoln University.**

Focus:
Tourist trampling and experiences at Rotorua geothermal sites
Natural Asset:
Rotorua's geothermal sites (including vegetation)

Classification:
Vegetation
Activity:
Walking, sight seeing (geothermal attractions)
Impact:
Vegetation trampling (resulting in reduced height and coverage), reduced vegetation regeneration, soil compaction
Indicator:
Changes in soil penetration resistance, vegetation cover/type/height, informal track formation

183. Ward, N.I., Brooks, R.R. and Reeves, R.D. 1974. Effect of lead from motor-vehicle exhaust on trees along a major thoroughfare in Palmerston North, New Zealand. ***Environmental Pollution 6:149-158.***

Focus:
Effect of lead on trees along major thoroughfare in Palmerston North, NZ
Natural Asset:
Adjacent forest to transport routes, NZ
Classification:
Vegetation
Activity:
Land vehicle use (transport, driving, bus travel)
Impact:
Contamination/pollution of soil, absorption of lead through root structure and contact, vegetation poisoning, stunted growth, possible food chain effects, accumulation of lead in trees through time.
Indicator:
Chemical analysis of leaves, bark, trunk, core samples showing lead existence and accumulation

184. Wardle, K., Fahey, B. 1999: Environmental effects associated with snow grooming and skiing at Treble Cone Ski Field. Part 1. Vegetation and soil disturbance. ***Science for Conservation 120A:*** **1-48.**

Focus:
Environmental effects of snow grooming and skiing
Natural Asset:
Vegetation and physical attributes on 3 Otago skifields on DoC land
Classification:
Vegetation, Physical
Activity:
Skiing
Impact:
Decreased vegetation cover (damage to cushionfields)
Indicator:
Ground cover (vegetation), soil density, soil penetration resistance, depths of A-horizon

185. **Wardle, K., and Wardle, R. 1992. The impact of a snow groomer on the vegetation and ground cover of Broken River Ski basin. Department of Conservation unpublished report.**

Focus:
Impact of snow groomer on vegetation and ground at Broken River Ski Field, NZ
Natural Asset:
Ski field terrain, Broken River NZ
Classification:
Vegetation, Physical
Activity:
Land vehicle use, snow groomer
Impact:
Vegetation damage, loss, compaction.
Indicator:
Change in percent cover of rock, bare ground, litter, live and dead vegetation, species diversity and abundance, tussock biomass

186. **Watson, A. and Watson, R.D. 1983.** ***The Lecht Ski Development The Impact on Soils and Vegetation and Recommendations for its Amelioration.*** **(Publisher unknown); Scotland.**

Focus:
Impact of skiing activities on soil/vegetation
Natural Asset:
Ski field terrain, Scotland
Classification:
Physical, Vegetation
Activity:
Skiing, related activities
Impact:
Vegetation damage/loss, soil erosion, exposure and subsequent erosion of peat soils, increased run-off of peat soils, species composition, changes in thermal conductivity, change drainage
Indicator:
Changes in terrain from base line information., percent bare ground, species composition change
Soil compaction

187. **Wilshire, H.G., Nakata, J.K., Shipley, S. and Prestegaard, K. 1978. Impacts of vehicles on natural terrain at seven sites in the San Francisco Bay area.** ***Environmental Geology 2(5): 295-319.***

Focus:
Vehicle impacts on natural terrain
Natural Asset:
Natural terrain in the San Francisco Bay area
Classification:
Vegetation, physical

Activity:
Land vehicle use (ORVs 4-wheel driving, motorcycle use, vehicle access to attractions)
Impact:
Loss of plant cover, increased loamy soil strength and bulk density, reduction of loamy soil moisture, organic content and infiltration, sandy soils have increased moisture and decreased strength, these impacts adversely affect wildlife and promote erosion
Indicator:
Change in vegetation cover, soil loss, soil strength/infiltration/density/moisture/ temperature/organic content

188. **Wood, T.F. 1987. Methods for assessing relative risk damage to soils and vegetation arising from winter sports development in the Scottish highlands.** ***Journal of Environmental Management 25 : 253-270.***

Focus:
Impact of winter sports on soils and vegetation, Scotland
Natural Asset:
Ski field terrain
Classification:
Vegetation, Physical
Activity:
Skiing and related activities
Impact:
Non-specific, vegetation loss, damage, soil erosion, changes in thermal conductivity
Indicator:
Species frequency, environmental variables, slope, snow depth, humus (organic layer) depth, soil moisture content

2.3 Physical

189. Alice Springs Arid Zone Resources Institute. 1972. *Environmental Characterisation Report, Ayres Rock – Mt Olga National Park.* Alice Springs Arid Zone Resources Institute; Australia

Focus:
Environmental effects of an expanded tourism industry
Natural Asset:
Ayres Rock
Classification:
Physical
Activity:
Walking, Camping
Impact:
Track degradation; wildlife disturbance; flora/fauna composition change and/or destruction
Indicator:
None specified

190. Ash, J. 1985. Adventure Caving Waitomo, Why? What? A Philosophical Ramble. Pp 38-48 in D.R. Williams and K.A. Wilde (Eds), *Cave Management in Australasia Proceedings of the sixth Conference on Cave Tourism and Management.* Waitomo Caves, New Zealand, September 1985.

Focus:
Caves
Natural Asset:
Waitomo Caves
Classification:
Physical
Activity:
Caving
Impact:
Visitor impacts
Indicator:
Regular visits and detailed cave log, photomonitoring (fixed photos)

191. Baarse, G. and Rijsberman, F.R. 1986. Ecology and tourism: Protecting the coast of the Dutch Island of Texel. *Project Appraisal 1(2):75-87*

Focus:
Tourism on coastal island Texel, Europe
Natural Asset:
Island environment, sand dunes, beaches
Classification:
Physical, Wildlife, Vegetation
Activity:
Camping, beach activities, water sports general

Impact:
Dune erosion, drinking water contamination and supply pressure
Indicator:
Changing rates of erosion, number of tourists, economic value of tourism

192. Baker, A. and Genty, D. 1998. Environmental pressures on conserving cave speleothems: effects of changing surface land use and increased cave tourism. *Journal of Environmental Management 153*, 165-175.

Focus:
Caves Speoleothems
Natural Asset:
Caves
Classification:
Physical
Activity:
Caving and viewing
Impact:
Degradation of stalagmites
Indicator:
CO_2 and calcium ion concentrations, temperature changes

193. Bonwick, J. and Ellis, R. 1985. New Caves for Old Cleaning, Restoration and Redevelopment of Show Caves. Pp 134-153 in D.R. Williams and K.A. Wilde (Eds), *Cave Management in Australasia Proceedings of the sixth Conference on Cave Tourism and Management,* Waitomo Caves, New Zealand, September 1985.

Focus:
Caves
Natural Asset:
Jenolan Caves
Classification:
Physical
Activity:
Caving
Impact:
Contaminants: Natural, visitor detritus (skin, litter, graffiti) and development (bolts, wire)
Indicator:
Visitor numbers; geometric effects (distance and level from path and entrance); cave microclimate (humidity, air velocity, temperature, morphology); and other effects (seasonal change, use of wire mesh)

194. Booth, K.L., Jones, N.C. and Devlin, P.J. 1999. Measuring the effects of aircraft overflights on recreationists in natural settings. ***Department of Conservation Technical Series 18.***

Focus:
Effects of aircraft overflights in natural areas.
Natural Asset:
Mt Cook, Milford Track
Classification:
Physical
Activity:
Aircraft related tours, climbing, mountaineering, walking
Impact:
Noise, human disturbance
Indicator:
Aircraft activity, visitor perceptions of impact, level of acceptance

195. Buerger, R., Hill, J. and Taggart, J. 1997. Understanding Recreational Use on Barrier Islands. ***Coastlines: 7.2 Spring***

Focus:
Recreation's impacts on barrier islands
Natural Asset:
Masonboro Island, North Carolina, USA
Classification:
Physical
Activity:
Beach activities general (sunbathing, beachcombing, picnicking), fishing, walking, wildlife, vegetation viewing
Impact:
No long-term recreational impacts exist due to the mitigating natural forces that are constantly reshaping the beach environment.
Indicator:
Erosion, sand disturbance

196. Bunting, B.W 1998. The impacts of recreational caving on the physical environment of wild caves. Waikato University; New Zealand

Focus:
The impact of recreational caving on the physical environment of wild caves
Natural Asset:
Wild caves (not modified for tourist development), NZ
Classification:
Physical
Activity:
Caving
Impact:
Erosion/compaction/transportation/deposition of cave sediments. Erosion/disturbance of rock surfaces. Modification to entrances. Litter, vandalism, deliberate breakage, graffiti. Disturbance to fossils.

Indicator:
Changes in: floor speleothems; silt/mud/sediment/rock; presence of litter; definition of trail; damage to walls; sediment disposition; colour contrast; damage to stalagmites/stalactites, erosion; surface polishing; carbide markings

197. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Routeburn Track. ***Science for Conservation 92.***

Focus:
Visitor perceptions of physical and social impact, Routeburn Track
Natural Asset:
Routeburn Track NZ
Classification:
Physical
Activity:
Walking, aircraft over flights
Impact:
Vegetation loss, soil compaction, track widening, crowding on track and at facilities, pressures on sewage disposal, litter, aircraft noise, fall out and pollution, wood cutting
Indicator:
Visitor perceptions of acceptable physical/social impacts and profiles, litter, track widening, vegetation loss/wood cutting, infrastructure development, water supply quality/quantity

198. Cilimburg, Amy, Monz, Christopher, and Kehoe, Sharon. 2000. Wildland Recreation and Human Waste: A Review of Problems, Practices, and Concerns ***Environmental Management 25:587-598***

Focus:
Impact of human waste in wilderness areas
Natural Asset:
Wilderness/natural areas
Classification:
Physical
Activity:
Walking, backcountry skiing, mountaineering
Impact:
Pollution of water courses and drinking water, introduced pathogens, transmission of pathogens
Indicator:
Fate of pathogens in the environment

199. Cole, D.N. 1983. Assessing and Monitoring Backcountry Trail Conditions. Research Paper INT-303. U.S.D.A. Forest Service. Intermountain Forest and Range Experiment Station.

Focus:
Assessing and monitoring backcountry trails
Natural Asset:
Backcountry areas in Big Creek, Montana, USA
Classification:
Physical,Vegetation
Activity:
Walking
Impact:
Physical deterioration (widening, deepening, damage to tread), vegetation damage/ change
Indicator:
Cross sectional area measurements (erosion), photos, significant ratings (consisting of track depth, width, moisture regime, stones and roots on the tread, walkability)

200. Commission for the Environment 1976. ***Remarkables Ski Field Environmental Impact Audit;*** **Commission for the Environment; Wellington**

Focus:
Impacts of ski fields, Remarkables
Natural Asset:
Ski field terrain, Remarkables NZ
Classification:
Physical, Vegetation
Activity:
Skiing, ski field related activities
Impact:
Visual impact of road, slope stability and erosion, impact of ski field facilities (sewage, rubbish, water supply, landscape values), vegetation loss
Indicator:
None specified

201. Crozier, M.J., Marx, S.L. and Grant I.J. 1977. Off-road Vehicle Recreation: The Impact of Off-road Motorcycles on Soil and Vegetation Conditions. ***Proceedings of the ninth N.Z. Geography Conference 9: 91-94***

Focus:
Impacts of off-road motorcycles on soil and vegetation.
Natural Asset:
Landscape, hill country, pasture
Classification:
Physical, Vegetation

Activity:
Land vehicle use (off-road motorcycling)
Impact:
Changes in soil and vegetation condition. Erosion, hydrological changes. Vegetation loss. Displacement of soil.
Indicator:
Degree of impact function, impact-making capabilities of the vehicle, sensitivity of terrain, number of vehicles, area of impact, soil moisture, bearing capacity, dry bulk density, infiltration capacity, vegetation loss

202. **Deluca, T.H., Patterson IV, W.A., Freimund, W.A. and Cole, D.N. 1998. Influence of Llamas, Horses, and Hikers on Soil Erosion from Established Recreation Trails in Western Montana, USA** ***Environmental Management 22:255-262***

Focus:
Impact of llama, horses and hikers on soil erosion. Montana, USA
Natural Asset:
Walking tracks, natural areas
Classification:
Physical- (also vegetation)
Activity:
Walking, horse and llama packing/riding
Impact:
Increased availability of sediment for run-off, increased erosion, channelling
Indicator:
Sediment yield and runoff, changes in soil bulk density, changes in soil surface roughness soil moisture, slope, rainfall intensity

203. **Dickman, M. and Dorais, M. 1976. The Impact of Human Trampling on Phosphorus Loading to a Small Lake in Gatineau Park, Quebec, Canada.** ***Journal of Environmental Management 5:335-344***

Focus:
Impact of human trampling on Phosphorus Loading to a small Lake in Gatineau Park, Canada
Natural Asset:
Lake system
Classification:
Physical, Vegetation
Activity:
Walking, walking, bicycle riding
Impact:
Increased soil erosion. Increased eutrophication – by phosphorus. Changes in phytoplankton species composition. Reduction in vegetation cover.
Indicator:
Substrate chemistry, water chemistry, species composition, track condition/vegetation loss

204. Doome, S. 2000. Caves, Cultures and Crowds: Carrying Capacity Meets Consumer Sovereignty. *Journal of Sustainable Tourism 8(2):116-130.*

Focus:
Waitomo caves carrying capacity, primary social, secondary ecological
Natural Asset:
Waitomo cave system
Classification:
Physical
Activity:
Walking, caving, black water rafting
Impact:
Increased CO_2 levels causing corrosion of speleothems. Degradation of biological, social, cultural values.
Indicator:
Visitor numbers and experiences. Ecological monitoring in place

205. Enzenbacher, D.J. 1994. Tourism at Faraday Station: an Antarctic Case Study. *Annals of Tourism Research* 21(2): 303-317.

Focus:
Scenery/, Wilderness
Natural Asset:
Faraday Station Antarctica
Classification:
Physical
Activity:
Boat tours Sightseeing Overnighting
Impact:
Tourist impacts on scientific research and environment
Indicator:
Number of tour boats visiting

206. Fahey, B and Wardle, K. 1998. Likely impacts of snow grooming and related activities in the West Otago ski fields. *Science for Conservation 85.*

Focus:
Impacts of snow grooming on West Otago ski fields
Natural Asset:
West Otago ski fields
Classification:
Physical, Vegetation
Activity:
Skiing, ski field related activities (eg. snow grooming)
Impact:
Snow pack compaction. Increase in heat flow rates and length of snow retention. Decreased porosity, permeability and water holding capacity. Related increased frost penetration and prolonging time soil remains frozen, in turn altering microbial activity and composition of plant communities through changes in

length of growing season and soil moisture availability. 70% reduction in abundance of soil fauna. Decrease in vegetation. Changes in soil chemistry.
Indicator:
Changes in; thermal conductivity, hydrological flow (compaction/porosity, seasonal run-off etc), soil fauna and flora composition, loss, damage, bare ground, litter, soil chemistry (e.g. Calcium, Potasium, Phosphate)

207. Fraser, K.W and Speedy, C.J. 1997. Hunting pressure, deer populations, and vegetation impacts in the Kaimanawa Recreational Hunting Area. ***Science for Conservation 47.***

Focus:
Recreational hunting impacts in the Kaimanawa recreational area.
Natural Asset:
Kaimanawa natural environments
Classification:
Physical
Activity:
Hunting, walking
Impact:
Vegetation recovery, reduction of deer numbers to well below ecological carrying capacity of selected areas
Indicator:
Hunting patterns and profiles, deer density, track and hut facilities, forest type, browsing pressure, seedling densities, regeneration

208. Gartner, W.C. 1987. Environmental impacts of recreational home developments. ***Annals of Tourism Research 14(1):*** **38-57.**

Focus:
Environmental impacts of recreational home developments
Natural Asset:
General- especially water bodies
Classification:
Physical, Vegetation, Wildlife
Activity:
Accommodation development (i.e. baches, holiday homes, etc)
Impact:
Degradation of water bodies primary impact (e.g. eutrophication from septic tank leakage, fertiliser runoff, siltation, and pollution), also erosion, increased fire risk, habitat destruction
Indicator:
Change in water quality

209. Geist, V. 1975. On the management of mountain sheep: theoretical considerations. Pp. 77-105 in Trefethen, J.B. (ed.) *The wild sheep in modern North America.* Winchester Press: New York.

Focus:
Management of mountain sheep
Natural Asset:
Mountain sheep in North America
Classification:
Wildlife (mountain sheep)
Activity:
Hunting, walking, wildlife viewing
Impact:
Habituation, behavioural disturbance
Indicator:
Change in population, change in behaviour

210. Goldberg, E. 1994. Coastal zone space: prelude to conflict? Paris: UNESCO Publishing, IOC Ocean Forum.

Focus:
Coastal zone conflict
Natural Asset:
Coastal environments
Classification:
Physical, Wildlife
Activity:
Fishing, boating, diving, walking, swimming
Impact:
Pollution, destruction of coral formations, pathogen intro, disturbance of fishlife, eutrophication of water
Indicator:
Decreased water quality, coral destruction

211. Grant I.J, Crozier, M.J. and Marx, S.L. 1977. *Off-road Vehicle Recreation Study Characteristics, Demand and Impact on the social and physical environment.* Applied Geology Consultants; Wellington.

Focus:
Off-road vehicle recreation impacts
Natural Asset:
Landscape, hill country, pasture
Classification:
Physical, Vegetation, Wildlife
Activity:
Land vehicle use (Off-road motorcycle and 4-wheel driving)
Impact:
Changes in soil and vegetation condition. Erosion, hydrological changes. Vegetation loss. Displacement of soil. Conflict with other users, trampers, farmers. Noise. Disturbance of wildlife

Indicator:
Degree of impact function, impact-making capabilities of the vehicle, sensitivity of terrain, number of vehicles, area of impact, soil moisture, bearing capacity, dry bulk density, infiltration capacity, vegetation loss, social conflict

212. **Hamilton, E.H. 1981.** ***The alpine vegetation of Marmot Basin, Jasper National Park, Alberta, and the impact of ski activities upon it.*** **M.Sc. Thesis, University of Alberta, Edmonton, Alberta, 170p.**

Focus:
Impact of skiing on alpine vegetation
Natural Asset:
Alpine vegetation of Marmot Basin, Jasper National Park, Alberta, Canada.
Classification:
Physical (also secondary impacts on vegetation)
Activity:
Skiing and ski-field services
Impact:
Alteration of snowmelt patterns, increased snow density, changed species composition
Indicator:
Change in snow density, snowmelt patterns, vegetation composition

213. **Hardwick, P. and Gunn, J. 1996. The conservation of Britain's limestone cave resource.** ***Environmental Geology 28(3):121-127***

Focus:
Impact of human activities on limestone caves, Britain
Natural Asset:
Limestone cave environments
Classification:
Physical, Wildlife, Vegetation
Activity:
Caving
Impact:
General
Indicator:
None specified

214. **Healy, R.G. 1999. Tourism in a Critical Environment: Brazil's Atlantic Coastal Forest. In Singh, T.V and Singh, S.** ***Tourism Development in Critical Environments.*** **Cognizant Communication Corporation; New York. Pp.77-88.**

Focus:
Tourism in a critical environment
Natural Asset:
Atlantic coastal forest

Classification:
Physical (also vegetation & wildlife)
Activity:
Beach activities general, caving, walking, climbing, fishing
Impact:
Eroded trails, pollution, proliferation of facilities, loss/damage to vegetation/wildlife
Indicator:
None specified

215. Heath, R. [date unknown]. *The environmental consequences of the off-road vehicle: with profiles of the industry and the enthusiast.* Source unknown.

Focus:
Environmental consequences of off road vehicles (ORVs)
Natural Asset:
Snow covered environs
Classification:
Physical (also vegetation & wildlife)
Activity:
Snow related activities, snowmobiles, skiing, snowshoeing
Impact:
Loss of soil temperature, increased snow melt times, delayed bacterial activity in spring, plant death/damage, delayed seed germination, delayed soil thaw
Indicator:
Change in snow compaction, soil temperature, snow melt times, vegetation cover/ composition/life cycles

216. Horn C 1994 Conflict in recreation: the case of mountain-bikers and trampers. Unpub. Thesis. MPRM Lincoln University, Canterbury

Focus:
Impact of user conflict in natural environments.
Natural Asset:
Physical/tracks
Classification:
Physical
Activity:
Mountain biking, walking
Impact:
Track damage, dispersing activities into more remote environments.
Indicator:
None specified

217. **Hoyos, M. Soler, V., Canaveras, J.C., Sanchez-Moral, S. and Sanz-Rubio, E. 1998. Microclimatic characterization of a karstic cave: human impact on microenvironmental parameters of a prehistoric rock art cave (Candamo Cave, northern Spain)** *Environmental Geology 33(4): 231-242*

Focus:
Impact of mass tourism on karst caves systems, Spain
Natural Asset:
Karst cave ecosystems
Classification:
Physical, Wildlife, Vegetation
Activity:
Caving, walking
Impact:
Changes in CO_2 concentrations, increased erosion, water pollution/turbidity/ sedimentation, temperature increase, ventilation increase, damage to cave paintings
Indicator:
Changes in: geochemical characteristics, cave ventilation, CO2, temperature, humidity

218. **James, J. 1992. Coastal tourism— the processes, the product and the use of this spectacular resource. Pp. 94-105 in Weiler, B. (Ed.)** *Ecotourism, incorporating The Global Classroom, 1991 International Conference Papers.* **Canberra: Bureau of Tourism Research.**

Focus:
Coastal tourism
Natural Asset:
Coastal areas in Australia
Classification:
Physical
Activity:
Facility development, swimming, boating, land vehicle use (ORVs), walking
Impact:
Development for tourists often results in alteration of natural beach sediment movement and causes increased inundation, erosion etc.
Indicator:
Change in physical structure of beach (e.g. sediment loss, dune destruction/erosion)

219. **Keane, P.A.; Wild, A.E.R.; and Rogers, J.H. 1979. Trampling and erosion in alpine country.** *Journal of the Soil Conservation Service of NSW, 35,* **7-12.**

Focus:
Trampling and erosion in alpine environs
Natural Asset:
Snowy Mountains, Australia

Classification:
Physical, Vegetation
Activity:
Walking, skiing, snow related land vehicle use
Impact:
Multiple tracking, gully/rill formation, trampling of vegetation, topsoil erosion, increased susceptibility of soil and vegetation to natural processes (wind, rain, etc)
Indicator:
Multiple track formation, erosion, vegetation damage

220. Keane, P.A., Wild, A.E.R., Rogers, J.H. 1980. Soil conservation on the ski slopes. *Journal of the Soil Conservation Service of NSW* 36(1): 6-15.

Focus:
Soil conservation on ski slopes
Natural Asset:
Australian ski fields
Classification:
Vegetation, Physical
Activity:
Skiing and ski-field services
Impact:
Soil erosion, surface soil exposure, damage/destruction of plants, multiple tracking
Indicator:
Change in erosion, vegetation cover; multiple track formation

221. Kirkby, S.J. 1996. Recreation and the quality of Spanish coastal waters. pp 189-211 in Barke, M., Towner, J., and Newton, M.T. *Tourism in Spain: Critical Issues*. Oxon: CAB.

Focus:
Recreation and water quality in Spanish coastal waters
Natural Asset:
Spanish coastal waters
Classification:
Physical
Activity:
General
Impact:
Deterioration of beaches and water quality, increased sewage load
Indicator:
Change in levels of pollutants pathogens etc

222. **Koenen, J.P., Chon, K.-S. and Christianson, D.J. 1995. "Effects of Tourism Growht on Air Quality: The Case of Las Vegas", *Journal of Sustainable Tourism, Vol 3:3, 135-142.***

Focus:
Effects of tourism growth on air quality
Natural Asset:
Las Vegas and its air quality
Classification:
Physical
Activity:
General
Impact:
Increases in tourism, tourist development, and local population growth thought to decrease air quality
Indicator:
Changes in air quality/pollution

223. **Kuss, F.R. 1983. Hiking boot impacts on woodland trails. *Journal of Soil and Water Conservation 38:119-121.***

Focus:
Walking boot impacts on trail erosion.
Natural Asset:
Walking tracks
Classification:
Physical
Activity:
Walking
Impact:
Organic matter deposition, increased run-off and trail erosion.
Indicator:
Organic matter deposition, run-off, imprinting

224. **Lance, A.N., Baugh, I.D. and Love, J.A. 1989. Continued footpath widening in the Cairngorm Mountains, Scotland. *Biological Conservation 49:* 210-214.**

Focus:
Footpath widening
Natural Asset:
Footpaths in the Cairngorm Mountains, Scotland
Classification:
Physical, Vegetation
Activity:
Walking
Impact:
Erosion, multiple tracking/track proliferation, track widening, vegetation loss/ damage

Indicator:
Change in width of bare ground, width of ground with damaged vegetation, overall width of path, number of tracks per path

225. Larcombe, P. and Woolfe, K.J. 1999. Increased sediment supply to the Great Barrier Reef will not increase sediment accumulation at most coral reefs ***Coral Reefs 18(2):163-169***

Focus:
Impact of cumulative activities causing sediment increase to the Great Barrier Reef, Australia
Natural Asset:
Coral reefs
Classification:
Physical, Vegetation, Wildlife
Activity:
Boating (including jet skis), swimming, snorkelling, diving, walking on coral
Impact:
Damage/destruction of formations, sediment displacement, increased pressure due to cumulative impacts of catchment management.
Indicator:
None specified

226. Lynch, P. 1996. Menstrual waste in the backcountry. ***Science for Conservation, No. 35.*** **Department of Conservation, Wellington. 41p.**

Focus:
Impacts from the disposal of menstrual waste
Natural Asset:
New Zealand backcountry
Classification:
Physical, Vegetation
Activity:
Walking, climbing, kayaking
Impact:
Aesthetic/ visual impact, water pollution
Indicator:
None identified

227. Manning, R.E. 1979. Impacts of recreation on riparian soils and vegetation. ***Water Resources Bulletin 15 (1): 30-41.***

Focus:
Impacts of recreation on riparian soils and vegetation
Natural Asset:
General-riparian soils/ vegetation
Classification:
Physical, Vegetation (riparian)

Activity:
Boating (launching), fishing, swimming, camping, picnics
Impact:
Trampling of vegetation/ soils, disturbance of surface leaf litter, increased erosion, reduced vegetation regeneration, root and plant damage
Indicator:
Changes in or site comparisons of: surface litter cover and depth, soil density/ compaction, vegetation damage, exposed soil/roots

228. Mason, P. and Leberman, S. 2000. Local Planning for Recreation and Tourism: A Case Study of Mountain Biking from New Zealand's Manawatu Region. ***Journal of Sustainable Tourism 8(2):97-115***

Focus:
Mountain bike tourism in Manawatu New Zealand, planning emphasis
Natural Asset:
Mountain bike/walking tracks
Classification:
Physical
Activity:
Mountain biking
Impact:
Technology of bikes allowing bikers into further remote areas. Damage of soil, water, vegetation
Indicator:
Conflict between users, environmental change, management level

229. Maysk, W.J. 1973. The snowmobile: a recreational technology in Banff National Park. Environmental impact and decision making, University of Calgary, Calgary, Alberta.

Focus:
Environmental impacts of snow mobiles
Natural Asset:
General snow covered environments
Classification:
Vegetation, Wildlife, Physical
Activity:
Snow related activities, snow mobiling, ski-field services
Impact:
Snow and soil compaction, decreased soil temps, plant destruction, early soil freezing, decreased soil bacterial activity
Indicator:
Increased soil/snow compaction, change in plant cover/composition, bacterial activity

230. McQuaid-Cook, J. 1977. Effects of Hikers and Horses on Mountain Trails. *Journal of Environmental Management 6:209-212*

Focus:
Effects of hikers and horses on mountain trails.
Natural Asset:
Walking tracks in hill country
Classification:
Physical, Vegetation
Activity:
Walking, horse trekking
Impact:
Soil compaction, accelerated gully erosion, vegetation damage and loss.
Indicator:
Existence of paths other than those designed for impact, change in vegetation, gully existence, soil density

231. Mercer, D. 1972. The environmental impact of outdoor recreation. In *Victoria's Resources:11-16*

Focus:
Impact of tourism on landscape

Natural Asset:
Wild landscape
Classification:
Physical
Activity:
General
Impact:
General , inclusive
Indicator:
None specified

232. Nelson, D. 1982. *Environmental impact analysis on the St James Walkway.* Unpublished dissertation, Department of Parks, Recreation and Tourism, Lincoln College.

Focus:
Impact of trampers on St James walking track and surrounding environment
Natural Asset:
St James Walkway, New Zealand
Classification:
Vegetation, Physical
Activity:
Walking, camping
Impact:
Soil compaction, vegetation loss, track widening and channelling, muddiness
Indicator:
Change in soil compaction, percent vegetation/litter cover

233. **Nordstrom, K.F. and Lotstein, E.L. 1989. Perspectives on resource use of dynamic coastal dunes.** ***The Geographic Review 79(1):1-12***

Focus:
Effects of use on coastal dunes
Natural Asset:
Coastal dunes
Classification:
Physical
Activity:
Water sports activities general (surfing, diving, snorkelling, swimming) boating (jet ski's, power boating, sailing, kayaking), walking, picnicking etc
Impact:
Erosion of dunes, destruction of vegetation
Indicator:
None specified

234. **Ovington, J.D., Groves, K.W., Stevens, P.R., and Tanton, M.T. 1972.** ***A study of the impact of tourism at Ayres Rock – Mt. Olga National Park.*** **Department of Interior; Canberra**

Focus:
Impact of tourism around Ayres Rock
Natural Asset:
Ayres Rock
Classification:
Physical
Activity:
Camping, walking, wildlife viewing
Impact:
Compaction of plants; wildlife disturbance; rock/track damage; increased area of influence; pollution (waste/litter)
Indicator:
Changes in/characteristics of tourist activities, vegetation type and area, soil and topography

235. **Palmer, J. 1985.** ***A report to the North Canterbury National parks and Reserves Board on Environmental Impact of the Lion Brown Coast-to-Coast Endurance Race Within Upper Minga and Reception Valleys, Arthur's Pass National Park.*** **Publisher unknown, New Zealand**

Focus:
National Park tracks
Natural Asset:
National Park tracks
Classification:
Physical, vegetation
Activity:
Endurance race event
Impact:
Track width increases. Increased angle of slope. Vegetation trampling

Indicator:
Observations before/after

236. Palmer, J.D. 1979. *The Goat Pass Track.* Lincoln College; Canterbury.

Focus:
Preservation and public access in Arthur's Pass, NZ
Natural Asset:
Goat Pass track, Arthur's Pass
Classification:
Physical, Vegetation
Activity:
Walking
Impact:
Trampling vegetation, increased mud and bare ground, impeded drainage, loss of vegetation and soil, compaction
Indicator:
Track counter and past records, track condition, photo points, soil type and depth, vegetation type, rainfall, management activities

237. Parizek, R.R. 1971. Impact of highways of the hydrogeologic environment. Pp. 151-199 in Coates, D.R. *Environmental Geomorphology.* New York: Publications in Geomorphology, State University of New York.

Focus:
Impact of highways on hydrogeologic environment
Natural Asset:
Hydrogeologic environment
Classification:
Physical
Activity:
Land vehicle use, roading/facility development
Impact:
Damage and pollution of water supplies, reduction of induced streambed infiltration rates, sedimentation, siltation causing flooding and erosion, obstruction of ground water flow, changes in runoff and recharge characteristics.
Indicator:
Change in: water quality, level of pollutants/silt, water flow characteristics (ground and surface)

238. Pearce, D.G. 1997. Skifield Development in New Zealand. *Proceedings of the ninth N.Z. Geography Conference 9: 91-94*

Focus:
Ski-field development in NZ
Natural Asset:
Mountain slopes

Classification:
Physical, Vegetation
Activity:
Skiing, land vehicle use
Impact:
Non-specific, development impact on towns
Indicator:
Numbers of skiers, accessibility, distribution of impacts, facility development, economic analysis

239. Pesant, A.R. 1987. Snowmobiling impact on soil properties and winter cereal crops. ***Canadian Field Naturalist 101:22-32.***

Focus:
Snowmobiling impact on soil properties and winter cereal crops.
Natural Asset:
Ski fields
Classification:
Physical
Activity:
Snow related activities, snow mobiling
Impact:
Increased density and transmitted heat. Decreased temperature under ski tracks and increased frost penetration
Indicator:
Density, compaction, thermal conductivity

240. Pulido-Bosch, A., Martin-Rosales , Lopez-Chicano, M., Rodriguez-Navarro, C.M., and Vallejos, A. 1997 Human impact in a tourist karstic cave (Aracena, Spain)Environmental Geology 31(3/4):142-149

Focus:
Tourist impacts in karst environments
Natural Asset:
Karst caves, Spain
Classification:
Physical, Vegetation, Wildlife
Activity:
Site seeing, cave walking, technical caving
Impact:
Decreased in level of water in pools, increased temperature and CO_2 concentration, decreased relative humidity, exotic plant colonisation, favoured by the lighting system, has irreversibly altered numerous speleothems.
Indicator:
Changes in: air temperature/humidity, CO2 levels, water levels, species composition, chemical composition

241. **Quinn, N.W, Morgan, R.P.C., and Smith, A.J. 1980. Simulation of Soil Erosion Induced by Human Trampling.** ***Journal of Environmental Management 10: 155-165.***

Focus:
Impact of walking on soil.
Natural Asset:
Soil, walking tracks.
Classification:
Physical, Vegetation
Activity:
Walking.
Impact:
Soil loss, run off.
Indicator:
Run off volumes, compaction, soil displacement

242. **Rautjoki, H.A. and Millar, I.R. 1985. Management of Honeycomb Hill Cave – An Example of Integrating of Conservation and Development. Pp 83-95 in D.R. Williams and K.A. Wilde (Eds),** ***Cave Management in Australasia Proceedings of the sixth Conference on Cave Tourism and Management,*** **Waitomo Caves, New Zealand, September 1985.**

Focus:
Caves Subfossil bird bones
Natural Asset:
Honeycomb Hill Cave System
Classification:
Physical (caves)
Activity:
Caving
Impact:
Natural change Damage ie (vandalism, souveniring and carelessness), exposed limestone
Indicator:
Photomonitoring of indicator sites; visitor data (permits, registers, and numbers) Research rates and processes of natural change [land management practices]

243. **Reid, L.M., Dunne, T. 1984. Sediment production from forest road surfaces.** ***Water Resources Research*** **20: 1753-1761.**

Focus:
Sediment production from forest roads
Natural Asset:
Forest environs and water bodies in the Pacific Northwest
Classification:
Physical, Wildlife
Activity:
Road provision/access to tourist attractions (eg ski-fields)

Impact:
Increased erosion, increased sediment contribution to water bodies resulting in decreased fish survival and water quality
Indicator:
Change in sediment yield, change in vehicle intensity, relationship between rainfall intensity, culvert discharge, sediment concentration and sediment discharge

244. Rodriguez, S. 1987. Impact of the ski industry on the Rio Hondo Watershed. ***Annals of Tourism Research 14(1):*** **88-103.**

Focus:
Impact of the ski industry on the Rio Hondo Watershed
Natural Asset:
The Rio Hondo Watershed, New Mexico
Classification:
Physical (water quality and biota)
Activity:
Snow related activities, ski resort development
Impact:
Water pollution (especially sewage), overuse of water supplies, reduction in macro-invertebrate and fish populations, increased in algal growths and scum
Indicator:
Change in water quality/ pollutant levels (e.g fecal coliforms, discharge levels, chlorine), biota populations, river flows/ water consumption

245. Schrind, W.D. 1971. Modification of the subnival microclimate by snowmobiles. In ***Proceedings, Symposium on snow and ice in relation to wildlife and recreation,;*** **pp. 251-257 Iowa State University Press; USA**

Focus:
Snowmobile impact on the subnival microclimate, Iowa
Natural Asset:
Ski field terrain
Classification:
Vegetation, Physical
Activity:
Land vehicle use, snow mobile
Impact:
Compaction, changes in density and temperature, reduction in insulative quality of snow cover by decreased depth and thermal conductivity
Indicator:
Vegetation cover, percent bare ground, density, thermal conductivity

246. **Shafer, Elwood L. and Yoon Jihwan 1998. Environmental Management of Human Waste Disposal for Recreational Boating Activities** ***Environmental Management 22:99-107***

Focus:
Disposal of human waste for recreational boating activities
Natural Asset:
Fresh water/marine ecosystems
Classification:
Physical, Vegetation, Wildlife
Activity:
Boating (power/jet sailing)
Impact:
Water pollution, pressure on sewage systems
Indicator:
Number of boaters and disposal activities, number of stations

247. **Shelby, B., Vaske, J.J., and Harris, R. 1988. User standards for ecological impacts at wilderness campsites.** ***Journal of Leisure Research 20(3):*** **245-256.**

Focus:
User standards for ecological impacts at wilderness campsites

Natural Asset:
Wilderness campsites
Classification:
Vegetation, Physical
Activity:
Camping
Impact:
General-Vegetation loss/bare ground and fire rings were examined in this paper
Indicator:
Area of bare ground and diameter of fire rings

248. **Sheridan, D. 1978. Dirt motorbikes and dune buggies threaten deserts.** ***Smithsonian 9(5):65-75***

Focus:
Impact of dirt bikes and dune buggies in desert areas.
Natural Asset:
Desert/sand dune areas
Classification:
Vegetation, Wildlife
Activity:
Land vehicle use (dirt bike riding, dune buggies)
Impact:
Destruction of desert environments. Decline/loss of flora and fauna.

Indicator:
Change in abundance, diversity of flora/fauna, evidence of damage to flora/fauna, number and distribution of off-road vehicles

249. Silverwood, N. 2000. The complex of Mega Mania. *Forest and Bird No 297:* 14-17.

Focus:
Damage to cave systems
Natural Asset:
Mega Mania cave, in Kahurangi National Park, NZ
Classification:
Physical (cave) Vegetation, Wildlife
Activity:
Caving
Impact:
Ecological disturbance from caving, camping, trampling, exploration, track erosion. Physical disturbance to fragile attributes in the cave
Damage to archaeological remains
Indicator:
Photo comparisons over time of 'sensitive' areas

250. Simmons, D. and Cessford, G. 1989 The St. James Walkway Study. Department of Parks, Recreation and Tourism; Lincoln College, New Zealand

Focus:
Environmental impacts on the St James walkway
Natural Asset:
St James Walkway, Lewis Pass, NZ
Classification:
Physical, Vegetation, Wildlife
Activity:
Walking
Impact:
Loss of topsoil and vegetation, erosion, compaction, decreased water infiltration capacity
Indicator:
Changes in vegetation, track movement, soil compaction/ infiltration/ strength, development of wet/boggy areas or erosion channels,

251. Smith, D., Cragg, A., Croker, G. 1990. Water Clarity Criteria for Bathing Waters Based on User Perception. *Journal of Environmental Management 33:* 285-291.

Focus:
Swimming
Natural Asset:
Bathing area

Classification:
Physical (water quality)
Activity:
Swimming
Impact:
Water quality
Indicator:
Change of perception to water quality

252. Sorokovikova, N.V. 1990. The overall effect of automobile transportation on the natural environment. ***Soviet Geographer XXXI: 116-125.***

Focus:
Effect of automobiles on the natural environment
Natural Asset:
Upper Oka Basin, Russia
Classification:
Physical, Vegetation, Wildlife
Activity:
Land vehicle use (road development and provision)
Impact:
Pollution/ emissions, noise disturbance, disturbance of landscapes, dissection of natural areas
Indicator:
Change in traffic intensity, pollutant emissions, relative pollution level, disconnectedness of natural areas

253. Stewart, D.P.C.; Cameron, K.C. 1992. Effect of trampling on the soils of the St James Walkway, New Zealand. ***Soil Use and Management*** **8(1): 30-36.**

Focus:
Trampling of soils
Natural Asset:
Soils of the St James Walkway, NZ
Classification:
Physical
Activity:
Walking
Impact:
Increased soil density/ compaction, erosion, track widening
Indicator:
Soil: density, organic content, water content, stability/ shear strength

254. Stewart, D.P.C. 1985. *Effects of trampling on the soils of the St James Walkway, Lewis Pass.* Unpublished BAgSc(Hons) thesis, Lincoln College.

Focus:
Effects of trampling on the soils of walking tracks (St James Walkway)
Natural Asset:
St James Walkway, New Zealand
Classification:
Physical (soil)
Activity:
Walking
Impact:
Increased bulk density, soil strength, decreased infiltration, increased runoff/ erosion
Indicator:
Changes in bulk density, soil strength, infiltration rate, organic and clay content, aggregate stability, chemical composition

255. Summer, R. 1986. Geomorphic impacts of horse traffic on montane landforms. *Journal of Soil and Water Conservation 41:126-128.*

Focus:
Impact of horses on montane landforms.
Natural Asset:
Hill slopes, tracks, low mountain passes.
Classification:
Physical
Activity:
Horse trekking/packing.
Impact:
Soil erosion, run-off, trail instability
Indicator:
Erosion patterns in differing transects of trail geomorphology, site description and change, vegetation displacement, increase in mud, deposition

256. Tetteroo, R. 1983. *St James Walkway research project, 1982-83 (Year 2).* Unpublished dissertation, Department of Parks, Recreation and Tourism, Lincoln College.

Focus:
Impact of walking and camping on the St James walking track
Natural Asset:
the St James walking track, New Zealand
Classification:
Physical, vegetation
Activity:
Walking, camping
Impact:
Track deterioration/ widening/ erosion,

Indicator:
Change in track quality and width, camping area

257. The Mount Cook and Southern Lakes Tourist Company Ltd. 1975. *Environmental Impact Report for Remarkables Ski Field* (Publisher unknown); New Zealand

Focus:
Impacts and mitigation for the Remarkables ski field proposal
Natural Asset:
Ski field terrain, Remarkables, NZ
Classification:
Physical, Vegetation
Activity:
Skiing and related activities
Impact:
Destruction/damage of vegetation, change in drainage, soil compaction, change in thermal conductivity, soil and rock displacement and disposal of spoil, erosion, washouts and channelling by roading
Indicator:
None specified

258. VanHassel, J.H., Ney, J.J. and Garling (Jr.), D.L. 1980. Heavy metals in a stream ecosystem at sites near highways. *Transactions of the American Fisheries Society 109:* 636-643.

Focus:
Heavy metals from highways in stream ecosystems
Natural Asset:
Back Creek area, Virginia, USA
Classification:
Physical, Wildlife
Activity:
Land vehicle use (access to attractions)
Impact:
Build up of heavy metals (zinc, lead, nickel) in stream sediments, benthic insects and fish
Indicator:
Changes in the concentrations of heavy metals in stream sediments, fish, etc; traffic intensity

259. Webb, R. 1989. Adventure Cave Destruction through management – Some Hard Facts. Pp 55-77 in K.A. Wilde (Ed), *Cave Management in Australasia Proceedings of the eighth Australasia Conference on Cave Tourism and Management,* Paparoa National Park, Punakaiki, New Zealand.

Focus:
Archaeology Ecology Geology Cave Chambers

Natural Asset:
Leeuwin Naturaliste National Park, Western Australia
Classification:
Physical (Limestone massif)
Activity:
Caving (also visiting, viewing, collecting)
Impact:
Damage to cave ecology unsustainable
Indicator:
Visitor numbers estimated and averaged from visitor books and visitor surveys

260. Wellington Regional Council. 1992. *Trail Bike Riding in the Wellington Metropolitan Area R/1/10/3*. Wellington Regional Council, Wellington N.Z.

Focus:
Impact of trail bike riding
Natural Asset:
Wellington metropolitan region, New Zealand
Classification:
Physical, Vegetation
Activity:
Land vehicle use (trail bike riding)
Impact:
Formation of bogs and erosion channels, soil compaction, vegetation destruction
Indicator:
Changes in soil structure (compaction, infiltration, strength, erosion), water quantity/ quality, plant cover/ composition/ diversity

261. Wheeler, G.L. and Rolfe, G.L. 1979. The relationship between daily traffic volume and the distribution of lead in radside soil and vegetation. *Environmental Pollution 18:265-274.*

Focus:
Relationship between daily traffic volume and the distribution of lead in soil and vegetation, Illinois USA
Natural Asset:
Features adjacent to roadsides
Classification:
Vegetation, Physical
Activity:
Land vehicle use (driving, transport)
Impact:
Increased lead levels in vegetation and soil, lead poisoning of vegetation and soil contamination
Indicator:
Chemical analysis of soil, vegetation

262. Williams, D.R. 1985. The future of cave tourism in Waitomo. In D.R. Wiliams and K.A. Wilde (eds), *Cave Management in Australasia- Proceedings of the sixth Australasian Conference on Cave Tourism and Management, Waitomo Caves.* T.H.C. Waitomo Caves, New Zealand, September 1985.

Focus:
Cave tourism in Waitomo
Natural Asset:
Waitomo Caves, NZ
Classification:
Physical, Wildlife
Activity:
Caving, wildlife (glow worm) viewing,
Impact:
CO2 build up, corrosion, increased cave temperature, lampenflora growth, vandalism, souveniring, glow worm disturbance, water pollution, litter, erosion, soil/ sediment introduction,
Indicator:
Damage to cave formations, change in temperature/CO_2 levels, growth of lampenflora, decreased water quality, sediment deposits, presence of litter/ graffiti, decreased glow worm activity

263. Williams, D.R. 1989. Information Collection at Waitomo Caves. Pp 172-174 in K.A. Wilde (Ed), *Cave Management in Australasia Proceedings of the eighth Australasia Conference on Cave Tourism and Management,* Paparoa National Park, Punakaiki, New Zealand.

Focus:
Caves
Natural Asset:
Waitomo Caves
Classification:
Physical (Cave system)
Activity:
Caving (Visiting and viewing)
Impact:
Cave damage
Indicator:
Environmental Monitoring: Climate (inside and outside of cave), cave ecology, and hydrology (flow records inside and outside of cave). Visitor records, and cultural history.

264. Wilson, J.P and Seney, J.P. 1994. Erosional impact of hikers, horses, motorcycles, and off-road bicycles on mountain trails in Montana. *Mountain Research and Development 14(1):77-88.*

Focus:
Relative erosional impacts of hikers, horses, mountain bikes and motorcycles on mountain trails.

Natural Asset:
Mountain trails.
Classification:
Physical
Activity:
Land vehicle use (motorcycling, mountain biking), walking, horse trekking.
Impact:
Water run-off, soil erosion.
Indicator:
Water run-off, sediment yield

2.4 General

265. APEC Tourism Working Group. 1995. *Tourism and the Environment Symposium, Christchurch, May 1-2 1995.* APEC.

Focus:
General- managing tourism and the environment
Natural Asset:
General- Asia-Pacific tourism/ environmental resources
Classification:
General
Activity:
General ecotourism- including camping, boating, skiing, fishing, caving, backpacking
Impact:
General-CO2 emission, sewage, garbage,
Indicator:
No specific indicators-mention of EIA's and situation analysis (consisting of assessment of ecological, infrastructural, cultural, institutional and legal attributes)

266. Archer, B. and Cooper, C. 1994. "The positive and negative impacts of tourism". Pp. 73-91 in Theobold, W.F. (Ed.) *Global Tourism: The Next Decade.* Oxford: Butterworth-Heinemann.

Focus:
Environmental/ ecological effects of tourism
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
Skiing, fishing, boating, walking, photography, wildlife viewing, land vehicle use, swimming, diving, climbing, hunting, facility development,
Impact:
Loss of landscape values, water pollution, litter, ecosystem destruction, excess water consumption, erosion, over development, damage/ destruction of vegetation and wildlife, wildlife disturbance
Indicator:
No specific indicators described but deemed as necessary for use with cost-benefit analysis (CBA)

267. Archer, E. 1985 Emerging environmental problems in a tourist zone: The case of Barbados. *Carribbean Geography 2(1):45-55*

Focus:
Emerging environmental problems in the Barbados
Natural Asset:
Island environments, sand dunes, beaches
Classification:
Physical, Wildlife, Vegetation

Activity:
Boating (power boating, sailing, kayaking, surfing, jet ski's), water sports general (diving, snorkelling, swimming), accommodation
Impact:
Waste disposal, sand dune degradation, nutrient enrichment and bacterial contamination of coastal waters, damage to corals
Indicator:
Evidence and increasing levels of contaminants, damage to corals, species composition, dune destruction

268. Audubon International 1989 Nature tourism in the wider Carribean. ***Audubon International Network: Developing International Partners.*** **Washington DC: National Audubon Society**

Focus:
Nature tourism in the Carribean
Natural Asset:
Island environments, beaches, sand dunes
Classification:
Physical, Wildlife, Vegetation
Activity:
Boating (jet ski's, power boating, sailing, kayaking), water sports general (surfing, diving, snorkelling, swimming), accommodation
Impact:
Waste disposal, sand dune degradation, nutrient enrichment and bacterial contamination of coastal waters, damage to corals
Indicator:
None specified

269. Bacon, P.R. 1987. Use of wetlands for tourism in the Insular Carribean. ***Annals of Tourism Research 14(1):*** **104-117.**

Focus:
Impacts of tourism on wetlands, Carribean
Natural Asset:
Wetlands, Carribean
Classification:
Vegetation, Physical, Wildlife
Activity:
Sight seeing, accommodation,
Impact:
Drainage and filling in of wetlands for construction of tourist facilities and insect control; loss of habitat, species composition change, vegetation/wildlife destruction and displacement
Indicator:
Change in habitat, incentives for enacting change

270. Baines, G.B.K. 1982. South Pacific Island tourism: Environmental costs and benefits of the Fijian example. In F. Rajotte (ed.) *The Impact of Tourism Development in the Pacific* pp.53-74; Trent University; Ontario, Canada

Focus:
South Pacific Island tourism
Natural Asset:
Island environments
Classification:
Physical, Vegetation, Physical
Activity:
Boating (jet skis, power boating, sailing, kayaking), water sports general (surfing, diving, snorkelling, swimming), camping, walking, accommodation facilities
Impact:
General
Indicator:
None specified

271. Baldwin, M.F. 1970. *The Off-Road Vehicle and Environmental Quality.* The Conservation Foundation; Washington DC

Focus:
Impacts of off-road vehicles
Natural Asset:
Natural areas, USA
Classification:
Vegetation, Physical, Wildlife
Activity:
Land vehicle use (ORV, including Motorbikes and snow mobiles)
Impact:
Excessive noise, wildlife disturbance, damage and loss of vegetation, trail and stream bank erosion, increased litter
Indicator:
Vegetation loss/damage, changes in erosion levels, evidence of litter

272. Barker, W.H.; Brown, A.J. 1979. *Preservation and Recreation.* Joint Centre for Environmental Science, Occasional Paper No 9.

Focus:
Preservation and recreation in rural lands
Natural Asset:
NZ rural environment
Classification:
Vegetation, Physical, Wildlife
Activity:
Walking, water sports general (swimming), land vehicle use, fishing, etc
Impact:
Litter, pollution, trespass, crop/ soil/ vegetation damage, social disbenefits
Indicator:
EIA's, social assessments, social carrying capacity

273. Bayfield, N.G. 1973. Use and deterioration of some Scottish Hill Paths. ***Journal of Applied Ecology 10: 635-644***

Focus:
Effects of walking/walking on Scottish hill paths.
Natural Asset:
Landscape, tracks.
Classification:
Physical, Vegetation
Activity:
Walking, running.
Impact:
Trampling of vegetation, increased bare ground, compaction, canalisation.
Indicator:
Lateral spread of paths, susceptibility of vegetation types

274. Beamish, S.F. 1977. ***Summary of a report on the Route Burn Track.*** **Mount Aspiring National Park Board.**

Focus:
EIA of walking on the Route Burn Track, Mt Aspiring National Park
Natural Asset:
Route Burn Track, Mt Aspiring National Park
Classification:
Physical, Vegetation
Activity:
Walking, camping
Impact:
Vegetation and soil trampling, increased erosion, reduced soil infiltration, water pollution
Indicator:
Track/ hut activity, vegetation cover, soil compaction, extent of erosion, track user feedback

275. Berle, P.A.A. 1990. Two faces of eco-tourism. ***Audubon 92(2):6***

Focus:
Threats of eco-tourism on the environment
Natural Asset:
Natural areas in general
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Inclusive including; trampling of vegetation, compaction of soil, waste disposal, wildlife disturbance
Indicator:
None specified

276. **Bird, E.C.F. 1982. Australia: Management of tropical coastal resources. In *Man, land and sea: Coastal resource use and management in Asia and the Pacific* pp.77-84; The Agriculture Development Council; Bangkok**

Focus:
Management of coastal resources
Natural Asset:
Coastal resources, Australia
Classification:
Physical, Vegetation, Wildlife
Activity:
General (coastal/marine activities), boating, water sports general (diving, surfing, snorkelling etc), camping, wildlife viewing
Impact:
General
Indicator:
None specified

277. **Bodini, Antonio, Ricci, Angela and Viaroli, Pierluigi 2000. A Multimethodological Approach for the Sustainable Management of Perifluvial Wetlands of the Po River (Italy) *Environmental Management 26:59-72***

Focus:
Sustainable Management of Perifluvial wetlands
Natural Asset:
Po River (Italy)
Classification:
Wildlife, Vegetation
Activity:
Photography, wildlife viewing, boating, fishing, land vehicle use
Impact:
General
Indicator:
None specified

278. **Boo, E. 1990. *Ecotourism: The potential's and pitfalls.* Vol. 2. WWF, USA.**

Focus:
Ecotourism effects in various S. American countries
Natural Asset:
Various
Classification:
General
Activity:
Wildlife viewing, sight seeing, coastal activities general etc
Impact:
General- examples cited include: litter, destruction of coral formations, trail erosion, waste water and soap in rivers, illegal hunting and fishing, disruption of wildlife behaviour, fire, graffiti on natural features

Indicator:
None specified

279. Boo, E. 1990. *Ecotourism: The potential's and pitfalls.* Vol. 1. WWF, USA.

Focus:
Environmental impacts of ecotourism

Natural Asset:
Various
Classification:
Vegetation, Physical, Wildlife

Activity:
Photography, wildlife viewing, guided tours, coastal/marine activities general, walking, mountain climbing
Impact:
General- examples cited include: deforestation, deterioration of vegetation, litter, toilet waste, wildlife disturbance, habitat destruction, erosion, souveniring, service/ infrastructure provision
Indicator:
Forest/ vegetation loss, presence of litter, wildlife population decline, erosion

280. Booth, K. and Cullen, R. 1995. Recreation Impacts. *In* Devlin, P.J., Corbett, R.A. and Peebles, C.J. (eds) *Outdoor Recreation in New Zealand.* Wellington: DOC and Lincoln University.

Focus:
Impacts of outdoor recreation
Natural Asset:
General
Classification:
General
Activity:
General,
Camping, walking, land vehicle use, climbing, mountain. biking, etc
Impact:
Soil and plant community change from vehicles and trampling- (including reduced spp div, spp displacement, removal of plant cover, erosion, reduced productivity)
Wildlife-habitat, behaviour, breeding, population changes
Indicator:
Visitor numbers- intensity/regularity/frequency, changes in organic matter/ vegetation cover/ soil fauna, weed presence, infiltration capacity, carrying capacity

281. Booth, K. Recreation- a positive force for island restoration. Pp. 278-283 in Towns, D.R., Daugherty, C.H., and Atkinson, I.A.E. (Eds.), 1990. *Ecological restoration of New Zealand's islands.* Conservation Sciences Publication No. 2. Department of Conservation, Wellington, New Zealand.

Focus:
Recreational use of NZ's islands
Natural Asset:
New Zealand islands
Classification:
Vegetation, Physical, Wildlife
Activity:
Boating, water sports general (swimming, diving), photography, wildlife viewing, walking, camping
Impact:
Litter, human waste, vegetation trampling, wildlife disturbance, increased fire threat, pest intro, wildlife behavioural change
Indicator:
Change in wildlife behaviour, increased incidence of litter/waste/fire/pests

282. Boyle, S.A and Samson, F.B. 1983. *Non-consumptive outdoor recreation: An annotated bibliography of human-wildlife interactions* (Special Scientific Report-Wildlife #252): Washington DC; USA

Focus:
Non-consumptive outdoor recreation
Natural Asset:
Natural areas and wildlife
Classification:
Wildlife, Physical, Vegetation
Activity:
Photography, wildlife viewing
Impact:
General, inclusive
Indicator:
None specified

283. Bramley, R. and Carter, B. 1992. Bridging the gap between resource protection and tourism utilisation. Pp. 108-116 in Weiler, B. (Ed.) *Ecotourism, incorporating The Global Classroom, 1991 International Conference Papers.* Canberra: Bureau of Tourism Research.

Focus:
Tourism planning
Natural Asset:
Natural tourism assets in Australia
Classification:
Vegetation, Wildlife, Physical
Activity:
General
Impact:
Direct physical attrition or loss of physical, flora and fauna resources, alteration of aesthetic character of an area
Indicator:
None specified

284. **Briguglio, L. 1992. Tourism impact on the environment of small islands with special reference to Malta.** ***Occasional Papers in Economic Development 46.*** **Faculty of Economic Studies, University of New England; USA**

Focus:
Tourism on small islands
Natural Asset:
Off-shore islands, Malta
Classification:
Wildlife, Vegetation, Physical
Activity:
Accommodation, water sports general (swimming, snorkelling, boating), sight seeing, photography
Impact:
Increased demand for building/waste disposal; introduction of dangerous chemicals/products to the environment (eg. emissions), increased demand for space, dangers to the marine environment (eg. destruction of flora and fauna), increased dumping of human waste, over fishing
Indicator:
None specified

285. **Buchanan, B. 1982. Controlled tourism - Soloman Islands. In. F. Rajotte (ed.)** ***The Impact of Tourism Development in the Pacific*** **pp.204-207; Trent University; Ontario, Canada**

Focus:
Tourism in the Solomon Islands
Natural Asset:
Island environment
Classification:
Physical, Vegetation, Wildlife
Activity:
Wildlife viewing, water sports general (surfing, diving, snorkelling, swimming), boating (jet ski's, sailing, kayaking), beach walking, camping/accommodation
Impact:
General, inclusive
Indicator:
None specified

286. **Buckley, Ralf and Pannell, John 1990 Environmental Impacts of Tourism and Recreation in National Parks and Conservation Areas.** ***Journal of Tourism Studies1(1)***

Focus:
Environment impacts of tourism on National Parks and Conservation Reserves
Natural Asset:
Australian National Parks and Conservation Reserves
Classification:

Physical, Vegetation, Wildlife
Activity:
General including: land vehicle use and travel related accommodation
Impact:
Soil erosion/ compaction, vegetation damage, wildlife disturbance, water pollution, increased fire risk, vandalism, noise

Indicator:
Intensity of use, water pollution/ depletion/ change of course, wildlife behavioural change, trampled soil/vegetation, weed/fungi growth

287. Buckley, R. 1999 Sustainable Tourism and Critical Environments. In Singh, T.V and Singh, S. *Tourism Development in Critical Environments.* Cognisant Communication Corporation; New York. Pp. 21-34

Focus:
Sustainable tourism in critical environments
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
General, including: land vehicle use and travel related accommodation, resorts, non-motorised recreation
Impact:
General, impacts on physical environment including, runoff sewage, pollution and erosion to land; impacts to biological environments including disturbance, introduction of weeds/pathogens, damage and clearance
Indicator:
None specified

288. Buckley, R. 1999. Tools and Indicators for Managing Tourism in Parks. *Annals of Tourism Research a Social Science Journal 26(1).* 207-210.

Focus:
Conservation reserves
Natural Asset:
Conservation reserves
Classification:
General
Activity:
Various
Impact:
Various
Indicator:
None specified

289. **Budowski, G. 1976. Tourism and environmental conservation: Conflict, coexistence, or symbiosis?** ***Environmental Conservation 3 (1):*** **27-31.**

Focus:
Tourism (general) and environment conservation
Natural Asset:
General
Classification:
General
Activity:
General including: walking, photography, wildlife viewing, facilities, accommodation
Impact:
Various- including: resource degradation, wildlife population decreased, habitat disturbance, cultural disturbance, litter
Indicator:
None specified

290. **Burger, Joanna 1998. Attitudes About Recreation, Environmental Problems, and Estuarine Health Along the New Jersey Shore, USA** ***Environmental Management 22:869-876***

Focus:
Social perception of impacts of tourism in an estuarine and beach environment.
Natural Asset:
Estuarine environments, New Jersey, USA
Classification:
Wildlife, Vegetation
Activity:
Wildlife viewing, swimming, boating (and jet skis), fishing
Impact:
Over fishing, water pollution, noise pollution, increased/changes in wave action (from boats), introduction of exotic flora/fauna
Indicator:
None specified

291. **Burgess, J. 1992. Softly softly minimising the impact of ecotourism in Tasmania. Pp. 89-93 in Weiler, B. (Ed.)** ***Ecotourism, incorporating The Global Classroom, 1991 International Conference Papers.*** **Canberra: Bureau of Tourism Research.**

Focus:
Minimising impacts of tourism in Tasmania
Natural Asset:
Tasmania, Australia
Classification:
Vegetation, Wildlife, Physical
Activity:
Walking, boating (including rafting, canoeing), fishing, caving, land vehicle use (eg. 4WD)

Impact:
River bank collapse from boat wakes, track degradation, water pollution, plant community decline, sheet erosion,
Indicator:
None specified, EIAs used to assess environment impacts

292. Calais, S.S. and Kirkpatrick, J.B. 1986. Impact of trampling on natural ecosystems in the Cradle Mountain-Lake St Clair National Park. ***Australian Geographer 17(1): 6-15.***

Focus:
Trampling impacts on natural ecosystems
Natural Asset:
Cradle Mountain- Lake St Clair National Park, Australia
Classification:
Vegetation, Physical
Activity:
Walking
Impact:
Vegetation loss, track damage, erosion, mud accumulation, soil compaction
Indicator:
Change in vegetation cover, multiple tracking, increased erosion

293. Canestrelli, E., Costa, P. 1990. Tourist Carrying Capacity: A Fuzzy Approach. Annals of tourism research 18(2): 295-311

Focus:
St Mark's Basilica
Natural Asset:
Surface area of historical centre of Venice
Classification:
General
Activity:
Viewing (cultural tourism: day trippers/hotel and non-hotel tourists)
Impact:
Congestion, trash,. Decrease in quality of experience
Indicator:
Carrying capacity based on bed, meal, parking space availability, water transportation system, solid waste disposal and St Mark's Basilica capacity

294. Cessford, G.R. and Dingwall, P.R. 1997. Wilderness and Recreation in New Zealand International Journal of Wilderness 3(4):39-43

Focus:
Wilderness recreation in NZ
Natural Asset:
Conservation lands/wilderness areas
Classification:
General

Activity:
Walking
Impact:
Dispersal of tourists into backcountry increasing impacts on tracks/wildlife. Pest invasion.
Indicator:
Visitor activities, management activities

295. Cessford, G.R and Dingwall, P.R. 1996. Tourist Visitors and their Experiences at New Zealand Subantarctic Islands. ***Science and Research Series 96.***

Focus:
Tourist visitors and their experiences at New Zealand Subantarctic Islands
Natural Asset:
Sub-Antarctic Islands
Classification:
Physical, Wildlife, Vegetation
Activity:
Boating (eg. cruise ships), walking (guided tours etc), wildlife viewing, photography
Impact:
Wildlife disturbance, pressure on facilities
Indicator:
Visitor profile and characteristics, visitor perceptions, management level

296. Cessford, G.R. and Dingwall, P.R. 1997. Impacts of visitors on natural and historic resources of conservation significance: Part 1- Workshop proceedings. ***Science and Research Internal Report, No. 156,*** **Department of Conservation, Wellington.**

Focus:
Visitor impacts on DoC lands-Physical
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife (DoC lands)
Activity:
General; land vehicle use, camping, hunting, fishing, walking
Impact:
General-
direct, habitat, behavioural
Indicator:
Visitor Impact Management, Limits of Acceptable Change, Tiered approaches, broad focus, trend analysis

297. Cessford, G. 1995 Off-road impacts of mountain bikes: a review and discussion. Department of Conservation/Te Papa Atawhai; Wellington

Focus:
Physical and Social impacts of Mountain Bikes on back country tracks in NZ

Natural Asset:
Backcountry tracks, water courses, landscape.
Classification:
Physical, Vegetation, Wildlife
Activity:
Mountain Biking
Impact:
Compaction, vegetation loss, rutting/channelling, excessive erosion, muddiness, increased number of trails.
Indicator:
Vegetation loss, uphill and downhill erosion, compaction, number of tracks, channelling, perceptions of environmental impact

298. Cessford, G. 1995. Conservation benefits of public visits to protected islands. *Science and Research Series No 95,* Department of Conservation, Wellington.

Focus:
Conservation benefits of visits to protected islands
Natural Asset:
NZ protected islands
Classification:
Physical (offshore islands)
Activity:
Wildlife viewing, photography, education tours, restoration
Impact:
Benefits included increased commitment to conservation, involvement in conservation efforts on the island.
Indicator:
Visitor feedback, management feedback

299. Cessford, G. 1997. Visitor satisfactions, impact perceptions and attitudes toward management options on the Tongariro Circuit Track. *Science for Conservation 65,* Department of Conservation, Wellington.

Focus:
Visitor perceptions of the Tongariro Circuit Track
Natural Asset:
Tongariro Circuit Track, NZ
Classification:
Physical, Vegetation
Activity:
Walking, camping
Impact:
Litter, vegetation damage, track formation/ widening, toilet paper/ waste
Indicator:
Visitor feedback and responses

300. Cessford, G.R. 1997. Visitor satisfaction's, impact perceptions and attitudes toward management options on the Kepler Track. ***Science for Conservation 70: 1-54.***

Focus:
Visitor perceptions of the Kepler Track

Natural Asset:
Kepler Track, NZ
Classification:
Physical, Vegetation
Activity:
Walking, camping
Impact:
Trampling of vegetation, track formation/ widening, overdevelopment, litter, toilet paper/ waste
Indicator:
Visitor feedback and responses

301. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Travers-Sabine Circuit Track. ***Science for Conservation 91.***

Focus:
Visitor perceptions of impacts, Travers-Sabine Circuit Track
Natural Asset:
Travers-Sabine Circuit Track NZ
Classification:
Physical
Activity:
Walking
Impact:
Track compaction, widening, vegetation loss, litter, water quality decrease, crowding.
Indicator:
Visitor perceptions of acceptable physical/social impacts and profiles, litter, track widening, vegetation loss/wood cutting, infrastructure development, water supply quality/quantity

302. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Abel Tasman Coastal Track. ***Science for Conservation 76.***

Focus:
Visitor perceptions of impact, Abel Tasman Coastal Track
Natural Asset:
Abel Tasman Coastal Track
Classification:
Physical, Vegetation
Activity:

Walking, boating (kayaking, motor boats)
Impact:
Campsite litter, decreased quality and quantity of water supply, over crowding, disturbance from motor boats, track trampling damage (widening, compaction, erosion) and existence of parallel tracks, impact both social and physical of infrastructure

Indicator:
Visitor perceptions of acceptable impact and profiles, level of infrastructure

303. Cessford, G. 1998. Sea-kayaker satisfaction's, impact perceptions and attitudes toward management options in Abel Tasman National Park. ***Science for Conservation 79.***

Focus:
Sea-kayaker perception of impact in Abel Tasman National Park
Natural Asset:
Abel Tasman National Park
Classification:
Physical
Activity:
Boating (sea-kayaking), walking
Impact:
Campsite damage, littering, water quality degradation, waste disposal, over crowding
Indicator:
Visitor perceptions of acceptable impact and profiles, level of management, litter, waste disposal, numbers of visitors

304. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Rakiura Track. ***Science for Conservation 80.***

Focus:
Visitor perceptions of impact on the Rakiura Track
Natural Asset:
Rakiura walking track
Classification:
Physical
Activity:
Walking, wildlife viewing, photography
Impact:
Trampling of vegetation, impact of infrastructure construction(boardwalks/huts), water quality decline, waste increase, litter, track widening, compaction.
Indicator:
Visitor perceptions of acceptable impacts and profiles, physical change, litter/waste/pollution

305. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Heaphy Track. ***Science for Conservation 82.***

Focus:
Visitor perceptions of impact, Heaphy Track
Natural Asset:
Heaphy walking track
Classification:
Physical
Activity:
Walking, wildlife viewing, photography
Impact:
Trampling of vegetation and tracks (compaction, track widening), litter at huts and on track, decreased water quality
Indicator:
Visitor perceptions of acceptable impacts and profiles, physical change, litter/waste/pollution, water quality

306. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Milford Track. ***Science for Conservation 87.***

Focus:
Visitor impact perceptions, Milford Track
Natural Asset:
Milford Track NZ
Classification:
Physical, Vegetation
Activity:
Walking, aircraft over flights
Impact:
Noise pollution, track damage from widening, trampling effects, compaction, vegetation loss
Indicator:
Visitor perceptions of acceptable physical/social impacts and profiles, litter, track widening, vegetation loss/wood cutting, infrastructure development, water supply quality/quantity

307. Cessford, G. 1998. Visitor satisfaction's, impact perceptions, and attitudes toward management options on the Lake Waikaremoana Track. ***Science for Conservation 73.***

Focus:
Visitor perceptions of impact, Waikaremoana walking track
Natural Asset:
Waikaremoana walking track
Classification:
Physical, Vegetation
Activity:

Walking, boating (kayaking, motor boats)
Impact:
Uncertain water hygiene, track trampling damage (widening, erosion, compaction), litter, waste disposal, introduced weeds/pests over crowding
Indicator:
Visitor perceptions of physical and social impacts, visitor profile, level of management

308. Cessford, G.R and Dingwall, P.R. 1994. Tourism on New Zealand's Sub-Antarctic Islands. ***Annals of Tourism Research 21 (2):318-332***

Focus:
Tourism on Sub-Antarctic Islands
Natural Asset:
Sub-Antarctic Islands
Classification:
Wildlife, Physical, Vegetation
Activity:
Boating (shipborne cruises), wildlife viewing, photography
Impact:
Damage in isolated wilderness areas. Pressure on existing facilities and science stations. Collection of souvenirs, pollution, physical damage, wildlife disturbance, introduction of weeds and animal pests
Indicator:
Visitor perceptions and profiles, ecological damage, level of infrastructure and management restriction.

309. Cessford, G.C. 1995. Canoeing and Crowding on the Wanganui River. Science and Research Series 97.

Focus:
Canoeing and crowding on the Wanganui River
Natural Asset:
Wanganui river systems
Classification:
Physical, Vegetation, Wildlife
Activity:
Boating (canoeing/kayaking)
Impact:
Water pollution and related health issues, litter, vegetation damage, human waste.
Indicator:
Visitor activity and profile, crowding perceptions, perceptions of pollution and human waste, perceptions of vegetation damage

310. Cessford, G.R. 1999. Social impacts of visitors to conservation lands: Part 1- Research and information needs. ***Science and Research Internal Report, No. 171,*** **Department of Conservation, Wellington.**

Focus:
Visitor effects and impacts on DoC land and info needs-Social

Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Social impacts
Indicator:
Surveys of Visitor perceptions, experiences

311. **Cessford, G.R. 1997. Impacts of visitors on natural and historic resources of conservation significance: Part 2- Research and information needs.** ***Science and Research Internal Report, No. 157,*** **Department of Conservation, Wellington.**

Focus:
Visitor effects and impacts on DoC land and info needs-Physical
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Physical damage- damage/displacement
Wildlife disturbance- responses to noise, human presence
Hazard introduction- Intro of weeds, pests, litter
Indicator:
Comparison of post-impact behaviours, distributions, characteristics with baseline data. Also ecosystem recovery or reaction to impacts, weed spread

312. **Cessford, G.R. 1999. Social impacts of visitors to conservation lands: Part 2- Workshop proceedings.** ***Science and Research Internal Report, No. 172,*** **Department of Conservation, Wellington.**

Focus:
Visitor effects and impacts on DoC land and info needs-Social
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Social impacts as a result of crowding, conflicting values, inappropriate uses, anti-social behaviour, commercial vs non-commercial use
Indicator:
Post-workshop investigations into: track counters, visitor satisfaction/ experience surveys, recreation noise impacts

313. Cessford, G.R. and Dingwall, P.R. 1999. An approach to assessing the environmental impacts of tourism. ***Conservation Advisory Science Notes No. 247,*** **Department of Conservation, Wellington.**

Focus:
Research/info needs and framework for tourism impacts on the environment
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
Physical damage, Wildlife disturbance, Hazard introduction
Indicator:
No specific indicators, however comparison of current state with baseline data was emphasised

314. Chappell, H.G.; Ainsworth, J.F.; Cameron, R.A.D.; Redfern, M. 1971. The effect of trampling on a chalk grassland ecosystem. ***Journal of Applied Ecology 8:*** **869-882.**

Focus:
Trampling on a chalk grassland ecosystem
Natural Asset:
Farley Mount, Winchester, England
Classification:
General
Activity:
Walking, land vehicle use
Impact:
Trampling stress
'Population reduction for arthropods, worms, molluscs and hygrophile species
Reduction in certain plant species
Soil compaction and decreased stability
Change in plant composition
Indicator:
Plan composition, evident trampling, soil structure

315. Clement, C. and Richardson, J. 1971. Recreation on the Georgia Coast-An Ecological Approach. ***Georgia Business 30:24***

Focus:
Recreation on the coastal areas of Georgia
Natural Asset:
Coastal areas; Georgia, USA
Classification:
Vegetation, Physical, Wildlife

Activity:
Coastal activities general (including surfing, diving swimming), boating (including power boating), etc
Impact:
Damage to coastal marine system, general
Indicator:
None specified

316. Cohen, E. 1978. The impact of tourism on the physical environment. *Annals of Tourism Research* 5(2): 215-229.

Focus:
Impacts of Tourism on the physical environment
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General including ecotourism, adventure tourism etc.
Impacts:
Over development, vegetation damage, wildlife disturbance, souveniring, trampling
Indicators:
No specific's, but contends that environmental impact is a functions of use intensity, ecosystem resiliency, time perspective of the developer and the character of tourism development.

317. Cole, D. 1989. Low-Impact Recreational Practices for Wilderness and Backcountry. General Technical Report INT-265. U.S.D.A. Forest Service. Intermountain Research Station.

Focus:
Recreation impact reduction in the wilderness/ and back country
Natural Asset:
Wilderness and backcountry (USA)
Classification:
General, Vegetation, wildlife, physical
Activity:
General
Impact:
Track erosion, soil/vegetation loss at campsites, litter, pollution of water resources, disturbance of wildlife and their habitats
Indicator:
Presence of litter, vegetation deterioration, wildlife behavioural changes, water contaminant levels, conflict/ crowding incidents

318. Cole, D.N. 1989. Wilderness Campsite Monitoring Methods: A Sourcebook. General Technical Report INT-259. U.S.D.A. Forest Service. Intermountain Research Station.

Focus:
Wilderness campsites monitoring methods
Natural Asset:
Wilderness campsites USA
Classification:
General, Vegetation, wildlife, physical
Activity:
General
Impact:
Various (see indicators)
Indicator:
Campsite area/ development, cleanliness, damage to overstory trees, tree reproduction, shrub damage, damage to ground cover vegetation, impacts to soil organic horizons and mineral soil, erosion, offsite impacts, summary ratings

319. Cole, D.N. 1994. The Wilderness Threats Matrix: A Framework for Assessing Impacts. Research Paper INT-475. U.S.D.A. Forest Service. Intermountain Forest and Range Experiment Station.

Focus:
Wilderness Threats Matrix for assessing impacts
Natural Asset:
Wilderness areas in northern Idaho and Montana, USA
Classification:
General
Activity:
General including walking, camping, fishing
Impact:
Soil erosion, vegetation degradation, reduced abundance and altered community structure of plants, water pollution, animal disturbance, loss of culture with development
Indicator:
Significance ratings and threat matrix

320. Cole, D.N., 1997. Soul of the Wilderness. ***International Journal of Wilderness 3(4):4-8.***

Focus:
Prioritizing areas for wilderness management
Natural Asset:
Landscape
Classification:
General
Activity:
Walking (short walks to attractions and backcountry)

Impact:
Numbers/impact relationship, impacts higher on low use areas than high use areas.
Indicator:
Degradation, vegetation survival

321. Cole, D.N., Watson, A.E., Hall, T.E., Spildie, D.R. 1997. *High Use Destinations in Wilderness: Social and Biophysical Impacts, Visitor Responses, and Management Options*. United States Department of Agriculture, Forest Service, Report no. INT-496, Rocky Mountain Research Station, Utah, USA.

Focus:
Wilderness and Forest lakes
Natural Asset:
National forests in Oregon and Washington States, USA
Classification:
Physical, Vegetation
Activity:
Walking , Camping
Impact:
System trails, social trails, campsites, lakeshores
Indicator:
Physical: System trail: root exposure, width, incision, braiding, muddiness, trail width, percent vegetation cover. Campsites: area disturbed (some plants), area barren (no plants), tree count (damage noted), fire scars. Shoreline: length of disturbed area. Social: visitor interviews, and observations of visitors.

322. Cole, D.N., Peterson, M.E. and Lucas, R.C. 1987. Managing Wilderness Recreation Use: Common Problems and Potential Solutions. *General Technical Report INT-230.*

Focus:
Identifying problems from recreational use of wilderness and strategies to ameliorate these.
Natural Asset:
Wilderness areas used for recreation (North America).
Classification:
Physical, Vegetation
Activity:
Walking, camping.
Impact:
Trail and campsite deterioration, litter, crowding, access impacts (eg. using pack-stock), human waste disposal, water pollution.
Indicator:
Management activities, wilderness educational level of visitors, deterioration of sites, wildlife behaviour.

323. Cole, D.N. 1982. Controlling the spread of campsites at popular wilderness destinations. *Journal of Soil and Water Conservation 37: 291-294*

Focus:
Controlling spread of campsites in wilderness areas.
Natural Asset:
Mineral soils, vegetation and habitat, water resources (North America).
Classification:
Physical, Vegetation
Activity:
General, camping.
Impact:
Moderate to great loss of vegetation in almost all campsite areas. High use concentrated in areas close to tracks and water leading to trail and campsite deterioration.
Indicator:
Vegetation loss, mineral exposure, tree damage, root exposure, development/ management activity, cleanliness, camp area, access trails

324. Coleman, E (ed.) 1988 Coastal tourism: Building local leadership 17(2):8 (1988)

Focus:
Coastal tourism management
Natural Asset:
Coastal environments
Classification:
Physical, Vegetation, Wildlife
Activity:
Nature tourism, photography, wildlife viewing, water sports general (surfing, diving, snorkelling, swimming), boating (jet skis, power boating, sailing, kayaking)
Impact:
General
Indicator:
Amount of litter, use of interpretation signs, increased/displaced erosion

325. Collier, A. 1994. *Principles of Tourism: A New Zealand Perspective 3rd Edition.* Longman Paul, Auckland, New Zealand.

Focus:
General tourism in NZ
Natural Asset:
NZ tourism assets
Classification:
Physical, Vegetation, Wildlife
Activity:
General including mass tourism, walking, camping, skiing

Impact:
Air/noise/water pollution, vegetation trampling and destruction, erosion, compaction, souveniring, resource consumption
Indicator:
Feedback from locals, interest groups or tourists

326. Cook, M. and Wells, R.J.G. 1983. "Environmental Planning for Tourism in the East Midlands". Pp. 55-66 in University of Bradford. *The Impact of Tourism and Recreation on the Environment, Occasional Paper No. 8.* University of Bradford.

Focus:
Environmental planning for tourism
Natural Asset:
East Midlands, England
Classification:
Physical, Wildlife, Vegetation
Activity:
Walking, wildlife, vegetation viewing, fishing, boating
Impact:
Air/water pollution, destruction and degradation of natural landscapes and flora and fauna
Indicator:
None specified

327. Coughlan, D. 1997. Recreational crowding in the New Zealand backcountry: Does experience affect it? *Environmental Perspective's 16:* 4-6.

Focus:
Recreational crowding in NZ backcountry
Natural Asset:
NZ backcountry
Classification:
Vegetation, Wildlife, Physical
Activity:
Camping, walking
Impact:
Crowding, loss of wilderness values
Indicator:
None specified

328. Craig-Smith, S.J. and French, C.N. 1994. *Learning to live with tourism.* Pitman: Melbourne, Australia.

Focus:
General tourism impacts
Natural Asset:
General

Classification:
Physical, Vegetation, Wildlife
Activity:
General, including caving, boating, aircraft related, land vehicle use (including ORV's), camping, walking, horse trekking, climbing
Impact:
Souveniring, erosion, water pollution, water sedimentation, fishlife disturbance, air pollution, vegetation damage, animal-vehicle collisions, wildlife death and disturbance, litter
Indicator:
Change in: pollution levels, vegetation damage, presence of litter

329. Crittenden, A. 1975. Tourism's terrible toll: The more it succeeds, the more tourism devastates the very basis of its existence. ***International Wildlife 5(2):4-12***

Focus:
Negative impacts of tourism
Natural Asset:
Natural areas
Classification:
Physical, Wildlife, Vegetation
Activity:
General
Impact:
General degradation of natural environments, loss of habitat, loss of species
Indicator:
None specified

330. Crotts J.C and Holland S.M. 1993. Objective Indicators of the Impact of Rural Tourism Development in the State of Florida. ***Journal of Sustainable Tourism 1(2):112-120***

Focus:
Indicators of the impact of rural tourism in Florida
Natural Asset:
Rural environment
Classification:
General
Activity:
General
Impact:
Increase of demand for services, increased pressure on water treatment, pollution, changes in manufacturing, agriculture, forestry etc
Indicator:
Quality of life indicators, health, income, disposable income, government expenditure

331. Curtis, S. 2000. All Terrain Destruction: Almost everyone agrees, ATVs need to be controlled— but how? *E: the Environment Magazine Vol XI:* 3.

Focus:
ATV (All terrain vehicle) impacts
Natural Asset:
General- United States
Classification:
Physical, Vegetation, Wildlife
Activity:
Land vehicle use (off road vehicle)
Impact:
Track formation, erosion, vegetation destruction and damage, wildlife harassment, habitat fragmentation, damage to riparian areas and the spread of weeds
Indicator:
Track formation, increased erosion, change in vegetation cover

332. Dahl, A.L. 1990. Conservation planning and environmental monitoring for tourism development. In proceedings of *Tourism in the South Pacific: The contribution of research to development and planning.* Rarotonga, Cook Islands. (Proceedings available from Dept of Geography, University of Canterbury, NZ)

Focus:
Conservation planning and environmental monitoring for tourism development, South Pacific
Natural Asset:
Natural areas
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General degradation of natural environments, loss of habitat, loss of species, social/economic impacts on local communities
Indicator:
None specified

333. Dasmann, R.F. 1982. Environmental impact of tourism. pp.48-52. In. F. Rajotte (ed.) *The Impact of Tourism Development in the Pacific* pp.204-207; Trent University; Ontario, Canada

Focus:
Environmental impacts of tourism in the Pacific
Natural Asset:
Pacific Islands (especially coastal areas)
Classification:
Physical, Vegetation, Wildlife

Activity:
General including fishing, water sports general (diving, snorkelling), facility development, souveniring
Impact:
Dredging and filling of wetlands, destruction of strand vegetation, siltation, intro of exotic plants and wildlife, depletion of wildlife and vegetation, habitat destruction, depletion of shellfish, pollution
Indicator:
Change in vegetation and wildlife species numbers/ diversity/ etc, pollution levels

334. Davidson, R. 1989. *Tourism*. London: Pitman.

Focus:
General physical environment
Natural Asset:
General physical environment
Classification:
Vegetation, Wildlife, Physical
Activity:
General including: facility development, hunting, wildlife viewing, photography, walking, camping, land vehicle use (ORVs), boating
Impact:
Decreased air and water quality, decreased vegetation/ wildlife diversity, sewage/ pathogen/ pollution introduction, vegetation damage and destruction, erosion, path widening, dune erosion, fire risk, wildlife habitat loss, behaviour/ breeding disturbances
Indicator:
Change in population numbers

335. Davis, D. and Tisdell, C. 1996. Managing Growth and Environmental Impacts in Recreational Scuba Diving. In Prosser, G. (ed.) Tourism and Hospitality Research Australian and International Perspective's. Bureau of Tourism Research; Australia. Pp.491-500.

Focus:
Impacts of recreational scuba diving
Natural Asset:
Coastal/marine environments, Australia
Classification:
Wildlife, Vegetation, Physical
Activity:
Boating and related activities (diving, motor boats)
Impact:
Damage of coral reefs, loss/damage of marine flora, water pollution
Indicator:
None specified

336. Department of Lands and Survey. 1978. *Tourism and the Environment.* Wellington: Department of Lands and Survey.

Focus:
Tourism impacts on the NZ environment
Natural Asset:
Queenstown and Bay of Islands, New Zealand
Classification:
Vegetation, Wildlife, Physical
Activity:
Skiing, land vehicle use (eg. coach tours, 4WD/ORVs), camping, walking, boating (jet boating, helicopter and scenic flights), rural farm stays, fishing
Impact:
Water pollution, eutrophication, air pollution, loss of landscape values, noise pollution, overdevelopment, litter, vegetation loss, erosion, increased runoff
Indicator:
Local community/ tourist feedback

337. Department of Lands and Survey. (date unknown) *Environmental Impact Assessment Proposed Kepler Track Fiordland National Park.* Department of Lands and Survey; Invercargill

Focus:
Environmental Impact Assessment for Kepler Track, NZ
Natural Asset:
Kepler walking track and environments
Classification:
Physical, Vegetation, Wildlife
Activity:
Walking, mountain biking
Impact:
Exceeding biological carrying capacity, construction damage including soil compaction and disturbance, vegetation loss, introduced pests/weeds – less impacts during maintenance. Track widening, vegetation trampling, wildlife disturbance, waste disposal, decreased water quality, existence of litter, introduced weeds/pests, fire, noise
Indicator:
Vegetation loss/damage, species composition/abundance/diversity. Change in water quality and supply. Campsite condition-evidence of rubbish and waste. Soil compaction and percent bare soil.

338. Department of Northern Territory Environmental Consultancy Group 1972. *A study of the impact of tourism at Ayres Rock, Mt Olga National Park.* AGPS; Canberra

Focus:
Current and projected ecological effects of tourism/recreation
Natural Asset:
Ayres Rock, Olga National Park

Classification:
Physical, Vegetation, Wildlife
Activity:
Sight seeing, camping
Impact:
Litter, compaction, erosion, track damage, vegetation loss, wildlife disturbance
Indicator:
None specified

339. **Devlin, P.J. and O'Connor, K.F. 1988. Exploring relationships of recreation users, impacts and management. In *Proceedings of a Symposium on Environmental Monitoring in New Zealand with an emphasis on Protected Natural Areas, Dunedin, May 1988.* Department of Conservation.**

Focus:
Recreational impacts on protected natural areas
Natural Asset:
Protected natural areas (PNAs) in NZ
Classification:
Physical, Wildlife, Vegetation
Activity:
General including walking, camping, boating, land vehicle use, climbing
Impact:
General- including physical damage, social impacts, disturbance of wildlife
Indicator:
Tourist satisfaction/ feedback, LAC

340. **Ding, Peiyi and Pigram, John. 1995. ENVIRONMENTAL AUDITS: An Emerging Concept in Sustainable Tourism Development *Journal of Tourism Studies 6(2)***

Focus:
Environmental auditing of tourism ventures, Australia
Natural Asset:
Natural areas, rural settings
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General inclusive
Indicator:
General, inclusive

341. Department of Conservation. 1994. Management techniques to reduce visitor impacts: a spatial manual for managers of outdoor recreation resources. Department of Conservation, Wellington, New Zealand.

Focus:
Mgmt techniques to reduce visitor impacts
Natural Asset:
NZ DoC Estate
Classification:
Vegetation, Physical, Wildlife
Activity:
General including walking, camping, boating (canoeing), wildlife viewing, photography etc
Impact:
Environmental . (litter, human waste, wildlife harassment, water contamination, vandalism of natural/ cultural sites) Social (crowding) Facility (tracks, campsites, huts, vandalism of facilities)
Indicator:
Change in wildlife behaviour, wildlife entanglement in litter, deterioration of water quality, presence of litter/ vandalism, track degradation, multiple tracking

342. Department of Conservation. 1996. *Visitor Strategy.* Department of Conservation: Wellington.

Focus:
Visitor strategy for the DoC estate
Natural Asset:
DoC Estate, NZ
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Vegetation clearance/trampling/destruction, track widening, soil erosion/ compaction, wildlife disturbance, habitat loss, water pollution, toilet waste, litter, noise/visual pollution, firewood collection, fire, weed/pest intro, vandalism, souveniring
Indicator:
None specifiied

343. Dolheguy, A. 1999. *Maori involvement in managing the environmental effects associated with the tourism industry.* MSc. Thesis, Lincoln University, New Zealand.

Focus:
Maori involvement in managing the environment effects of tourism
Natural Asset:
Maori environmental assets
Classification:
Physical, Vegetation, Wildlife

Activity:
General including walking, boating, camping, caving, wildlife viewing, fishing, hunting
Impact:
Water pollution, geological structure damage, souveniring, wildlife disruption, habitat loss, human waste, development, graffiti
Indicator:
None specified

344. Dowling, R. 1993. An Environmentally-based Planning Model for Regional Tourism Development. ***Journal of Sustainable Tourism 1(1):17-37***

Focus:
Environmentally based tourism planning
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
Cultural site damage, destruction of sand dunes, increased fire risk, litter, erosion, solid waste disposal, vegetation destruction, wildlife disturbance, reef damage, water pollution, air pollution, noise pollution
Indicator:
Unspecified. Environmental vulnerability. Tourist activity. Relationship between activity and place. Energetics/tourist flows. Facility development and provision.

345. Ecologically Sustainable Development Working Groups. 1991. ***Ecologically Sustainable Development Working Groups Final Report Tourism.*** **Australian Government Publishing Service; Canberra**

Focus:
Environmental impacts of tourism
Natural Asset:
Natural areas
Classification:
Wildlife, Vegetation, Physical
Activity:
General
Impact:
Clearance/damage to flora and fauna, introduction of exotic weeds/pests, nutrient/chemical changes to soil/food chains impacting on vegetation/fauna, barriers to wildlife movement, displacement, loss of soil productivity, soil erosion and compaction, soil contamination, increased air pollution from vehicle emissions, increased noise causing disturbance, increased turbulence on waterways, changes to hydrological conditions in rivers, groundwater, estuaries, increased nutrients/pollution to waterways, increased energy use (fuelwood), pressure on water/sewerage supplies, litter

Indicator:
None specified

346. Edgell, D.L. and Haenisch, R.T. 1995. *Coopetition: Global Tourism Beyond the Millennium.* Kansas City: International Policy Publishing.

Focus:
General
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
General including facility development, land vehicle use
Impact:
Polluted water sources and beaches, eroded landscapes, urban sprawl/ overdevelopment, noise pollution
Indicator:
None specified

347. Edington, J.M. and Edington, M,A. 1986. *Ecology, Recreation and Tourism.* Cambridge University Press; Cambridge, England

Focus:
Ecology, recreation and tourism effects
Natural Asset:
Natural areas
Classification:
Physical, Wildlife, Vegetation
Activity:
General including active physical pursuits, wildlife viewing, hunting, fishing
Impact:
General including; attraction/avoidance behaviour of wildlife, changes in species composition and community structures, impacts of construction of tourist facilities including soil compaction, habitat destruction, wildlife loss etc
Indicator:
Extensive range specific to situation including- behavioural/ breeding/ population changes, site/vegetation damage, soil compaction, weed spread

348. Edwards, J.R. 1987. The UK Heritage Coasts: An assessment of the ecological impacts of tourism. *Annals of Tourism Research 14(1):* 71-87.

Focus:
Ecological impacts of tourism along the UK Heritage Coasts
Natural Asset:
UK Heritage Coasts
Classification:
Physical, Wildlife, Vegetation

Activity:
Water sports general (sunbathing, swimming, windsurfing, snorkel/ diving), walking, boating, wildlife/vegetation study, fishing, land vehicle use (ORVs), climbing, camping
Impact:
Vegetation damage, erosion, wildlife disturbance (breeding, feeding, etc), habitat displacement/ destruction, loss of ground vegetation cover, excessive fossil collection/ souveniring, vandalism, litter, wood collection
Indicator:
None specified

349. Ensminger, J. Timothy, McCold, Lance N., and Webb, J. Warren 1999. Environmental Impact Assessment Under the National Environmental Policy Act and the Protocol on Environmental Protection to the Antarctic Treaty ***Environmental Management 24:13-23***

Focus:
Environmental protection of activities in Antarctica via the EIA process and Antarctic Treaty protocols
Natural Asset:
Antarctica
Classification:
Physical, Wildlife
Activity:
Wildlife viewing, photography, aircraft related (over flights etc)
Impact:
General environmental degradation
Indicator:
None specified

350. Farrell, B.H. and Runyan, D. 1991. Ecology and Tourism. ***Annals of Tourism Research 18: 26-40.***

Focus:
Ecology and tourism
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General
Indicator:
None specified

351. Foin, T.C., E.O. Garton, C.W. Bowen, J.M. Everingham, R.O. Schultz, and B. Holton, Jr. 1977. Quantitative studies of visitor impacts on environments of Yosemite National Park, California, and their implications for park management policy. *Journal of Environmental Management* 5: 1-22.

Focus:
Visitor impacts on national parks
Natural Asset:
Yosemite National Park, California, USA
Classification:
Wildlife, Vegetation, Physical
Activity:
Camping, walking, picnicking, mountain biking, photography, horse riding, fishing
Impact:
Trail formation, litter, vegetation damage/trampling, firewood collection,
Indicator:
Junks and Carex species used as trail impact indicators, vegetation cover, tree presence, vegetation/ wildlife densities

352. Gee, C.Y. (Ed.) 1997. *International Tourism: A Global Perspective.* Madrid: World Tourism Organization.

Focus:
Human impact on physical environment
Natural Asset:
General physical environment
Classification:
Vegetation, Wildlife, Physical
Activity:
General including Facility, accommodation development, land vehicle use (ORVs), boating, fishing, walking, souveniring, camping
Impact:
Wildlife irritation, behaviour change and disturbance, loss of natural landscape, erosion, competition with natural predators, noise pollution, vandalism, litter, habituation, wildlife mortality, soil/vegetation damage, dust, habitat destruction/ displacement, unnatural wildlife concentrations
Indicator:
Change in behaviour of wildlife soil/vegetation cover, mortality rates of vegetation and wildlife
Management guidelines including: policy/planning, development of facilities, management of resources/visitors, adapting the environment, marketing and promotion, education, research and monitoring

353. German Federal Agency for Nature Conservation (Ed.). 1997. *Biodiversity and Tourism: Conflicts on the World's Seacoasts and Strategies for Their Solution.* Springer-Verlag: Berlin.

Focus:
Biodiversity and tourism

Natural Asset:
General- world biodiversity
Classification:
Physical, Wildlife, Vegetation
Activity:
Coastal activities general (sunbathing, swimming, diving, non/motorised sports, sightseeing, wildlife viewing),
Mountain activities general (skiing, walking, mountaineering, climbing),
camping, boating (rafting), hunting, fishing
Impact:
litter, fecal matter, trampling vegetation, water pollution, stirring up sediment, noise, anchoring, wake waves, overfishing, track formation, infrastructure development, wood consumption, wildlife disturbance/ displacement, fire, souveniring, purchase of animals/parts, soil solidification
Indicator:
Change/loss of vegetation, soil erosion, animal disturbance/loss/population change, eutrophication, water pollution, reef damage, salinisation, biotope destruction

354. Giannecchini, J. 1993. Ecotourism: New Partners, New Relationships. ***Conservation Biology 7(2): 429-432***

Focus:
Ecotourism management
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General
Indicator:
Tourism activities and consumption patterns; conservation education level of tourists; dollar value of tourism

355. Glasson, J. 1995. ***Towards Visitor Impact Management: Visitor Impacts, Carrying Capacity and Management Responses in Europe's Historic Towns and Cities.*** **Avebury, England.**

Focus:
Visitor impact mgmt
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
Socio-cultural impacts-irritation to locals, commercialisation of culture, religion and arts, undermining of traditional crafts etc with cheap artificial imports

Environmental impacts- Noise, air and water pollution; litter; vegetation trampling; erosion; inappropriate building construction
Indicator:
EIA, carrying capacity, VIM, LAC,

356. Godfrey, P.J.; Leatherman, S.P.; Buckley, P.A. 1980. ORVs and barrier beach degradation. ***Parks 5 (2):*** **5-11.**

Focus:
ORV's and Barrier beach degradation
Natural Asset:
Cape Cod National Seashore, Massachusetts
Classification:
Physical, Vegetation (marine/coastal)
Activity:
Land vehicle use (ORVs)
Impact:
Crushed soil and plant/animal/marine species, increased erosion, degradation of dune system,
Indicator:
Track presence, presence of crushed plants/wildlife/soil

357. Goldsmith, F.B. 1983. Ecological effects of visitors and the restoration of damaged areas. In Warren, A. and Goldsmith, F.B. (eds), ***Conservation in Perspective, pp201-214.*** **Wiley and Sons.**

Focus:
Ecological effects of visitors and recreation
Natural Asset:
Various (focus Europe, N America, Australia)
Classification:
Vegetation, Physical, Wildlife
Activity:
General including: camping, walking, boating, skiing, horse riding, and land vehicle use
Impact:
Loss of vegetation, habitat disruption, animal/vegetation species damage, soil compaction
Indicator:
Visitor frequency/intensity, soil/vegetation species changes, wildlife behaviour/ population/breeding changes and responses

358. Good, R., Grenier, P. 1994. Some environmental impacts of recreation in the Australian Alps. ***Australian Parks and Recreation*** **30: 20-26.**

Focus:
Environmental impacts of recreation in the Australian Alps
Natural Asset:
Australian Alps

Classification:
Physical, Vegetation, Wildlife
Activity:
Snow related activities (skiing, snowboarding), walking, guided tours, walking, camping
Impact:
Vegetation damage/destruction, water pollution, sewage waste, intro of weeds/ animal pests and water borne disease/bacteria, erosion, multiple tracking,
Indicator:
Corroboree frog as indicator species, presence of water borne disease/bacteria

359. Graefe, A., Kuss, F. and Vaske, J. 1990. *Visitor Impact Management The Planning Framework;* National Parks and Conservation Association; Washington, D.C.

Focus:
Planning frameworks for impact management of tourism
Natural Asset:
Landscape, wilderness areas, watercourses, vegetation, wildlife
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General; ecological, physical social changes as result of visitor activity.
Indicator:
Physical: soil bulk density, compaction, pH, drainage, chemistry, productivity, area of bare ground, number of fire rings, visible erosion, tracks.
Biological: ground cover loss, density, composition, diversity, exposed tree roots, absence/presence of wildlife species, abundance of wildlife, reproductive success
Social: encounters with others/crowding, transportation, perception of natural environment, satisfaction/complaints, behaviour, rubbish.

360. Green, H., Hunter, C. and Moore, B. 1990. Application of the Delphi Technique in tourism. *Annals of Tourism Research 17:* 270-279.

Focus:
Application of the Delphi technique in tourism
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General
Indicator:
Delphi technique applied to range of stakeholders to identify concerns/issues

361. Greenberg, P.S. 1990 Taking responsibility for those polluted sites - Eco-tourism: Its time for the travel industry to step forward and address serious environmental problems caused by its own spiralling growth. ***Los Angeles Times April 22***

Focus:
Cleaning up tourism impacts
Natural Asset:
Tourist resorts, Thailand, Hawaii
Classification:
Physical, Wildlife, Vegetation
Activity:
General beach activities (surfing, diving, snorkelling, swimming), boating (jet ski's, sailing, kayaking), fishing, shellfish gathering, travelling
Impact:
Pollution from vehicle emissions, pressure to supply of water and electricity, increased waste and sewage disposal, felling of trees for water craft and souvenirs, depletion of shellfish and local fishing resources for food, damage to coral reefs, construction of facilities
Indicator:
None specified

362. Groome, K. Simmons, D., Clark, L. 1983. ***Recreational Users in Kaimanawa and Kaweka Forest Parks.*** **Dept. of Horticulture Landscape and Parks, Lincoln College, Bulletin No. 39.**

Focus:
Spatial areas within the forest park
Natural Asset:
Forest Parks - various
Classification:
General
Activity:
Hunting, tramping, sightseeing, nature study, picnicking, camping, fishing, rafting, kayaking
Impact:
Rubbish disposal
Indicator:
Visitor satisfaction

363. Hall, C.M and Johnston, M.E. 1995. ***Polar Tourism in the Arctic and Antarctic Regions*** **John Wiley and Sons; England**

Focus:
Polar tourism Antarctica/Arctic
Natural Asset:
Ice continents
Classification:
Physical, Wildlife, Vegetation

Activity:
Boating (cruise ships, small sailing ships), wildlife viewing, land vehicle use (overland vehicles), aircraft related activities (overflights), skiing
Impact:
Airborne; fall out such as hydrocarbon residues, wildlife disturbance of low flying craft. Evidence of panic stampedes of penguins and nest dissertion resulting in lower reproduction/fledgling rates. Evidence of caribou disturbance. Ship-based; pressure on regularly visited areas, water pollution, wildlife disturbance, introduction of weeds and animal pests and pathogens. Land-based; fresh water supply competition, water pollution, disposal of sewage and rubbish, disturbance to wildlife with related breeding and feeding impacts, introduction of pests/weeds/diseases, disruption to permafrost for construction, erosion, slumping, river siltation and drainage problems caused by construction of roads and airstrips.
Indicator:
Population dynamics, behaviour, breeding success, erosion, pollution (air, water, ice, marine, drainage), compaction of ice

364. Hall, C.M. and Page, S.J. 1999. *The Geography of Tourism and Recreation: Environment, Place and Space.* London: Routledge.

Focus:
General
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
General including Facility development, fishing, diving, boating, walking, snorkelling
Impact:
Water pollution (oil, sewage, waste water), litter, habitat change/destruction, loss of vegetation/wildlife species, interference with natural processes, erosion, introduction of exotic species, water siltation
Indicator:
Environmental assessments (EAs) and GIS suggested

365. Hall, M. and Wouters, M. 1994. Managing Nature Tourism in the Sub-Antarctic. *Annals of Tourism Research 21 (2):355-374*

Focus:
Managing nature tourism in the sub-antarctic
Natural Asset:
Antarctica
Classification:
Wildlife, Physical
Activity:
Sight seeing, wildlife viewing, aircraft related activities (over flights)

Impact:
Wildlife disturbance, vegetation loss, introduction of pathogens/species, increase requirement for waste disposal, introduction of chemicals/pollutants (emissions, oils etc), impact of facility construction
Indicator:
None specified

366. Hall C.M. 1995. *Introduction to tourism in Australia: impacts, planning and development.* Longman: Melbourne.

Focus:
Environmental impacts of tourism in Australia
Natural Asset:
Australian environment
Classification:
Physical, Wildlife, Vegetation
Activity:
General including Wildlife and vegetation viewing, camping, walking, land vehicle use, boating, hunting, fishing, photography, diving
Impact:
Vegetation and wildlife damage/destruction/disturbance, souveniring, wildfires, litter, trampling, track formation, weed/exotic plant intro, water/air pollution, erosion,
Indicator:
Loss/ change in vegetation, wildlife population/behaviour/habitat change, soil compaction, pollutants, erosion

367. Hammitt, W.E. and D.N. Cole. 1987. *Wildland Recreation: Ecology and Management.* John Wiley and Sons: Canada.

Focus:
Wildland ecological impacts of recreational use
Natural Asset:
Wildlands in the USA
Classification:
Physical, Vegetation, Wildlife
Activity:
General: including walking, camping, hunting, fishing, skiing, land vehicle use (ORVs, snowmobiles), boating, picnicking, swimming, horse riding, wildlife viewing, sport
Impact:
Soil- litter reduction and removal , trampling, raking, increased erosion and runoff, decreased infiltration/porosity;
Water: eutrophication; decreased flow; 0_2 (oxygen) depletion; pathogen/pollutant introduction; increased turbidity. Vegetation: trampling; damage; death; decreased reproduction/regeneration; composition change; decreased ground cover. Wildlife: disturbance/harassment; harvest; habitat modification; behaviour change; species displacement; decreased reproduction; species composition change; physical and psychological stress; decreased species diversity.

Indicator:
Change in 'camp' and 'disturbed' area, vegetation damage/loss, presence of human damage (eg axe marks, initials), vegetation cover, soil organic content, erosion, litter dispersal, condition class systems, mineral soil exposure/increase, root exposure, development (eg fire pits), informal trail presence, water quality (pathogen presence)

368. Harper, R.K. 1992. *Otago Recreation Opportunity Spectrum.* Miscellaneous Series N° 10. Department of Conservation (Otago Conservancy), Dunedin.

Focus:
Recreation Opportunity Spectrum: classification of areas according to setting and recreation
Natural Asset:
Otago Conservancy
Classification:
General (coastal; block mountain ranges and arid valleys; lakes; alpine and beech forest)
Activity:
Various
Impact:
Management Issues: Number of users; intensity of use; quality of recreation, facilities, roading and access; fire; soil/plant compaction; plant removal; quality of water and fishery; waste; safety; roading; disturb wildlife
Indicator:
None specified

369. Hay, J.E. (ed) 1992. *Ecotourism business in the Pacific : promoting a sustainable experience: conference proceedings.* Environmental Science, University of Auckland, and East-West Center, Honolulu, Hawaii.

Focus:
Ecotourism and sustainability in the Pacific
Natural Asset:
General- The Pacific's tourism/environmental resources
Classification:
General
Activity:
General
Impact:
General- resource depletion and pressure, decreased environmental quality, inappropriate development or design of buildings, impact on local values, loss of 'wilderness', litter
Indicator:
None specified- recommended a monitoring system assessing tourist satisfaction with respect to environment condition (e.g. crowding, ecological deterioration)

370. Herath, G. 1996. Ecotourism in Asia and the Pacific: Potential, Problems and an Integrated Plannign Model. In Prosser, G. (ed.) Tourism and Hospitality Research Australian and International Perspectives. Bureau of Tourism Research; Australia. Pp. 501-511

Focus:
Ecotourism in Asia and the Pacific
Natural Asset:
General
Classification:
Wildlife, Vegetation, Physical
Activity:
General
Impact:
General, including physical and chemical degradation of coral reefs, damage to mangrove systems, loss of fish/shellfish stocks
Indicator:
None specified

371. Hickman, T.E. 1990. *An Integrated Approach to Recreation Management in the Coastal Zone*. Unpublished MA Thesis, Auckland University, Auckland.

Focus:
Integrated Planning and Recreational carrying capacity
Natural Asset:
Whangaroa Harbour
Classification:
General (harbour environment)
Activity:
Enjoying scenery, fishing, scuba diving, boating, walking/tramping
Impact:
Soil compaction and properties, vegetation, water quality, wildlife disturbance, and air quality.
Indicator:
Water quality, vegetation, harbour ecology, water/waste level; Social and cultural values, perceptions, motivations, dis/satisfaction, preferences

372. Higham, J. 1994. The growth of wilderness tourism- Some important implications. *Environmental Perspectives 4:* 5-6.

Focus:
Implications of wilderness tourism in NZ
Natural Asset:
NZ wilderness
Classification:
Vegetation, Wildlife, Physical
Activity:
Camping, walking
Impact:
Degradation of wilderness values, crowding, 'environmental' damage

Indicator:
None specified

373. Hunt, J.D. 1981. *Some thoughts on wild river recreation carrying capacity.* College of Natural Resources, Utah State University.

Focus:
Wild river recreation carrying capacity
Natural Asset:
Wild river recreation areas
Classification:
Vegetation, Physical
Activity:
Boating (canoeing, kayaking), camping, picnicking
Impact:
Bank erosion, vegetation trampling, tree scarring, increased fire risk, litter, firewood collection,
Indicator:
None specified

374. Hutcheson, J, Walsh, P. and Given, D. 1999. Potential value of indicator species for conservation and management of New Zealand terrestrial communities. *Science for Conservation 109.*

Focus:
The use of indicator species for conservation management.
Natural Asset:
Vegetation, Wildlife
Classification:
Vegetation, Wildlife
Activity:
General
Impact:
Ecosystem deterioration and destruction.
Indicator:
Indicator species, distribution, abundance, species richness, demographics, genetic analysis

375. Inglis, Graeme J. , Johnson, Victoria I. , and Ponte, Fernando 1999 Crowding Norms in Marine Settings: A Case Study of Snorkelling on the Great Barrier Reef *Environmental Management 24:369-381*

Focus:
Impacts of overcrowding at Great Barrier Reef
Natural Asset:
Great Barrier Reef, Australia
Classification:
Physical, Wildlife
Activity:

Activity:
Water sports general (diving, snorkelling, swimming), boating (including jet skis)
Impact:
Detraction from tourist/recreational experience
Indicator:
None specified

376. Ives, J.D. 1974. Small-scale examples (1) The impact of motor vehicles on the tundra environments. Pp.907-910 in Ives, J.D. and Barry, R.G. (Eds) *Arctic and Alpine Environments.* Harper and Row: New York.

Focus:
Impact of motor vehicles on the tundra environments
Natural Asset:
Tundra environments
Classification:
Vegetation, Physical, Wildlife
Activity:
Land vehicle use (ORVs, 4wds, snowmobiles, trail bikes)
Impact:
direct damage to vegetation, harassment of wildlife, breeding disturbance, change in snow density characteristics (and impact on runoff/melt, soil moisture, plants), noise pollution, air pollution, litter, increased access and resulting impacts
Indicator:
None specified

377. Jackson, I. 1984. *Reference guidelines for enhancing the positive socio-cultural and environmental impacts of tourism- Enhancing the positive impact of tourism on the built and natural environment, Vol. 5.* Washington D.C.: Executive Secretariat for Economic and Social Affairs.

Focus:
Impacts of tourism development in the Carribean
Natural Asset:
Carribean islands
Classification:
Vegetation, Wildlife, Physical
Activity:
Facility development, diving, snorkelling, boating, fishing,
Impact:
Coastal erosion, loss of aesthetic qualities, waste/sewage/litter dumping, pathogen/bacteria introduction, overuse of water resources, wildlife disturbance
Indicator:
EIA promoted as best means of evaluation

378. Jeffries, B.E. 1987. Sagarmatha National Park and Tourism: A study of the background, impacts and relationships of tourism development and Park management responses in a World Heritage Site. Unpublished MapplSc Thesis, Lincoln University, NZ

Focus:
Impacts of tourism in Sagarmatha National Park
Natural Asset:
Sagarmatha National Park, Nepal (a World Heritage Site)
Classification:
Physical, Vegetation, Wildlife
Activity:
Mountaineering, walking, camping
Impact:
Rubbish dumping, human waste, deforestation (for firewood demands)
Indicator:
Water pollution levels, rubbish accumulation, deforestation

379. Karst *et al.* (2000) Reference unknown
Focus:
Lake eutrophication as a result of cumulative effects of recreational activities and riparian activities (agriculture)
Natural Asset:
Lake Opinicon
Ontario
Classification:
Physical, Vegetation, Wildlife
Activity:
Fishing, boating
Impact:
Nutrient enrichment: diatom-inferred [TP] increase
Indicator:
Changes in/existence of specific nutrient levels

380. Kearsley, G.W., Coughlan, D.P., Higham, J.E.S., Higham, E.C and Thyne, M.A. 1998. Impacts of tourist use on the New Zealand backcountry. *Research Paper 1.* Centre for Tourism; University of Otago, New Zealand

Focus:
Crowding/displacement in natural areas
Natural Asset:
New Zealand backcountry tracks, including great walks and other
Classification:
Physical, Wildlife, Vegetation
Activity:
Walking camping
Impact:
Track wear/compaction/erosion; increased noise (people/aircraft); track widening; perceived environmental degradation; litter

Indicator:
Number, type, activities and perceptions of visitors

381. Kearsley, G.W. 1981. The Impacts of Urban Recreation on the New Zealand Countryside. Pp.210-234 in Heenan, L.D.B. and Kearsley G.W (Eds). *Man Environment and Planning*. Otago University, Dunedin, New Zealand.

Focus:
Proximity of attractions to urban environments
Natural Asset:
General countryside
Classification:
General
Activity:
Various
Impact:
Perceived impacts on experience (as a result of physical impacts)
Indicator:
Analyse social groups and their lifestyle. Perceptual mapping. e.g., signs of perceived impacts: signs toilets etc, and number, presence of others

382. Kevan, P.G., Forbes, B.C., Kevan, S.M., Behan-Pelletier, V. 1995. Vehicle tracks on high Arctic tundra: their effects on the soil, vegetation, and soil arthropods. *Journal of Applied Ecology* 32: 655-667.

Focus:
Vehicle tracks on soil, vegetation and arthropods in high Arctic tundra
Natural Asset:
Soil, vegetation and arthropods in high Arctic tundra
Classification:
Vegetation, wildlife, physical
Activity:
Land vehicle use (access to attractions, ORVs)
Impact:
Increased depth of thaw, change in chemical composition of soil, decreased vegetation cover, decreased soil arthropod abundance (but not diversity), erosion, multiple track formation
Indicator:
Change in depth of thaw, chemical composition, vegetation cover, arthropod abundance

383. Kuss, F.R.; Graefe, A.R. and Vaske, J.J. 1990. Visitor Impact Management: A Review of Research. National Parks and Conservation, Association, Washington D.C.

Focus:
VIM Visitor Impact Mgmt

Natural Asset:
General
Classification:
Vegetation, Physical, Wildlife
Activity:
General including boating, camping, walking, land vehicle use, swimming,
Impact:
Changes to species composition, diversity of vegetation, soil properties and stability of the environment, behaviour and population of wildlife, and the quality of visitor's experience.
Indicator:
Extensive range discussed including direct and indirect forms of impact

384. Lankford, S.V and Howard, D.R. 1994. Developing a Tourism Impact Attitude Scale. *Annals of Tourism Research 21 (2):121-139*

Focus:
Tourism impact attitude scale, social, cultural and ecological impacts for local communities.
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
Perceived social, cultural, economic and ecological changes to local environs.
Indicator:
Degree of acceptance or rejection of change

385. Leiper, N. 1995. *Tourism Management.* Melbourne: RMIT.

Focus:
General
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
General including tourism development, wildlife viewing, camping, walking, photography, helicopter transport
Impact:
Over development (including architectural pollution and ribbon development), loss of wilderness, pollution, damage to physical features and vegetation, decreased water and air quality, wildlife disturbance
Indicator:
None specified

386. Lodico, N.J. 1973. *Environmental Effects of Off-road Vehicles: A Review of the Literature.* U.S. Department of the Interior; Washington DC

Focus:
Environmental effects of off-road vehicles
Natural Asset:
Natural areas, Virginia
Classification:
Vegetation, Wildlife, Physical
Activity:
Land vehicle use (ORVs)
Impact:
Loss/damage to vegetation/wildlife; soil compaction; noise causing disturbance; recreational conflicts
Indicator:
None specified

387. Loumou, A., Giourga, C., Dimitrakopoulos, P. and Koukoulas, S. 2000 Tourism Contribution to Agro-Ecosystems Conservation: The Case of Lesbos Island, Greece *Environmental Management 26:363-370*

Focus:
Impact of tourism activities on olive tree cultivation and the human agro-ecosystems
Natural Asset:
Agro-ecosystems
Classification:
Wildlife; Vegetation; Physical
Activity:
Viewing/participating in rural activities, ie. Site seeing; cycling; driving; accommodation
Impact:
Minimal in areas of stable residential population. Further investigation required.
Indicator:
None specified

388. Lucas, P.H.C. 1978. New Zealand National Report on the Environmental Consequences of Tourism. Pp. 7-21 in The Department of Lands and Survey. *Tourism and the Environment.* Wellington: Department of Lands and Survey.

Focus:
Environmental consequences of tourism in NZ
Natural Asset:
NZ natural environment
Classification:
Physical, Vegetation, Wildlife
Activity:
Various including holiday home use, camping, caravaning, walking

Impact:
Various including- water pollution, congestion, noise pollution, wildlife disturbance, vegetation/soil damage
Indicator:
None specified

389. Lucas, R.C and McCool, S.F. 1988. Trends in Wilderness Recreational Use: Causes and Implications. ***Western Wildlands 14(3):15-20***

Focus:
Wilderness use trends and associated impacts/issues for management.
Natural Asset:
Wilderness areas, landscape, wildlife
Classification:
Physical, Wildlife, Vegetation,
Activity:
General; walking, camping, rafting
Impact:
Crowding, general ecological impacts. Reverse impacts of changing nature of attractions with tourism decline, eg. encounters with grizzly bears, giardia in water, crowding.
Indicator:
Recreation use including numbers and changes in type and preferred location of use, reasons for declining visitor days, management activity encouraging/ discouraging visitors, ecological monitoring

390. Lunn, H. 1994. ***Tourism policy and the conservation estate: A tragedy of the commons.*** **Msc Thesis, Lincoln University, New Zealand.**

Focus:
Tourism impacts on NZ's conservation estate
Natural Asset:
NZ conservation estate
Classification:
Vegetation, Physical, Wildlife
Activity:
General
Impact:
Wildlife harassment, littering, vegetation destruction, water pollution, fire, indirect impacts (infra development)
Indicator:
None specified

391. Lusigi, W.J. 1978. ***Planning Human Activities on Protected Natural Ecosystems.*** **Strauss and Cramer; Germany.**

Focus:
Nairobi parks planning

Natural Asset:
National Park/landscape/freshwater
Classification:
Physical, Vegetation, Wildlife
Activity:
Wildlife viewing, photography, hunting
Impact:
Erosion, compaction due to vehicle use. Destruction of ecological systems, destruction of migratory routes, social separatism between tourists and locals. Pollution from sewage from infrastructure.
Indicator:
Wildlife health, population, diversity, infrastructure impact

392. Macdonald, Lee H., Anderson, Donald M., and Dietrich William, E. 1997 Paradise Threatened: Land Use and Erosion on St. John, US Virgin Islands *Environmental Management 21:851-863*

Focus:
Degradation of reefs and marine ecosystems through sedimentation from road development for tourism, Virgin Islands
Natural Asset:
Marine ecosystems
Classification:
Physical, Wildlife, Vegetation
Activity:
Land vehicle use facility development
Impact:
Increased levels of sedimentation causing damage and ecosystem change to coral reefs/marine ecosystems
Indicator:
Sediment transfer/build up/change in marine ecosystems, rate and disposal of run-off, traffic density

393. Manning, R.E., and Lime, D.W. 1996. Crowding and carrying capacity in the National Park System: Toward a social science research agenda. pp. 27-65 in Lime, D.W. (ed.) Congestion and crowding in the National Park System. *Miscellaneous Publication* 86-2996, Minnesota Agricultural Experiment Station, University of Minnesota, St Paul, Minnesota.

Focus:
Crowding and carrying capacity (especially social) in USA national parks
Natural Asset:
USA National Park System
Classification:
General
Activity:
Walking, camping, boating, canoeing, rafting,
Impact:
Dissatisfaction of other users, damage to soils/vegetation, wildlife disturbance

Indicator:
Use/crowding levels, carrying capacity (social and environmental), quality standards, LAC, VIM, carrying capacity, visitor profiles, visitor feedback/ satisfaction, GIS

394. Maragos, J. E. and Cook C.W. Jr. 1995. The 1991-1992 rapid ecological assessment of Palau's coral reefs. ***Coral Reefs 14(4):237-252***

Focus:
Ecological assessment for economic development of Palau's coral reefs
Natural Asset:
Coral reefs
Classification:
Physical, Wildlife, Vegetation
Activity:
Water sports general (diving, snorkelling, swimming, shellfish collection), accommodation, souveniring
Impact:
Damage to coral, over fishing, sedimentation from construction and increased road use
Indicator:
Changes in: biodiversity, sedimentation, chemical properties of marine systems, fish 'stocks', tourism activities and numbers

395. Marion, J.L. and Farrell, T.A. 1998. Managing Ecotourism Visitation in Protected Areas. Pp 155-181 in Lindberg, K., Wood, M.E., and Engeldrum, D. (Eds) ***Ecotourism: A Guide for Planners and Managers, Vol. 2.*** **North Bennington: The Ecotourism Society.**

Focus:
Ecotourism in protected areas
Natural Asset:
General protected natural areas
Classification:
Vegetation, Wildlife, Physical
Activity:
Generals including. facility development, walking, camping, wildlife viewing, boating, snorkelling, diving, horseback riding
Impact:
Various including- Vegetation/soil/wildlife disturbance, decreased vegetation cover/height/biomass, altered vegetation composition, loss of soil leaf litter and humus layers, erosion, compaction, decreased soil porosity and water infiltration, track widening, muddiness, multiple tracking, campsite expansion, wildlife habitat loss, disturbed wildlife breeding, sleeping and feeding, habituation, temporal/ spatial displacement, water pollution, increased turbidity/sedimentation/pathogen presence, souveniring
Indicator:
Example of campsite impact illustrated 6 indicators: vegetation loss, vegetation composition change, tree seedling loss, organic litter loss, exposed soil, soil

compaction (percentage change in these indicators was then plotted for campsites with different visitation levels)

396. Mathieson, A. and Wall, G. 1982. *Tourism economic, physical and social impacts. ;* Longman Scientific and Technical; England

Focus:
Physical impacts of tourism
Natural Asset:
General
Classification:
Vegetation Wildlife Physical
Activity:
Camping, walking, land vehicle use, boating, swimming, fishing, hunting, photography, wildlife/vegetation viewing
Impact:
Vegetation damage/loss of ground cover, changed vegetation and wildlife species composition, fire, litter, erosion, weed intro, pathogen intro, water and air pollution, nutrification of water, decreased in waters 0_2 content, noise pollution, wildlife death/disturbance/displacement, disrupted wildlife breeding/feeding/predator-prey relationships, habitat loss, vandalism, damage to geological formations
Indicator:
Soil compaction, vegetation cover, growth rates, species comp, age structure, wildlife death and disturbance, population change/comp, habitat change, pathogen/ pollutant presence, water nutrient levels, soil moisture/temperature/organisms/ aeration, erosion

397. McNeely, J.A, Harrison, J. and Dingwall, P. eds. 1994. *Protecting Nature Regional Reviews of Protected Areas;* IUCN; Gland, Switzerland

Focus:
Protecting nature, world-wide
Natural Asset:
Global natural areas
Classification:
Vegetation, Physical, Wildlife
Activity:
General
Impact:
General, inclusive
Indicator:
None specified, political and management activity

398. **McQueen, D. Environmental Impact of recreational use on Doc Estate. 1. Guidelines on track location, management and repair (Executive Summary). In Napper, J. (Ed.) 1991.** ***Historic resources, recreation, education and information: DOC science project summaries 1990/1991. Science and Research Internal Report No. 117.*** **Department of Conservation, Wellington.**

Focus:
Environmental impact of walking tracks
Natural Asset:
DoC Estate, NZ
Classification:
Physical, Vegetation
Activity:
Walking
Impact:
Erosion, soil compaction, decreased soil drainage
Indicator:
Track trenching/widening, new track formation, increased soil compaction, soil loss, visual degradation

399. **McQueen, D. Environmental Impact of recreational use on Doc Estate. 2. Effects of Camping (Executive Summary). In Napper, J. (Ed.) 1991.** ***Historic resources, recreation, education and information: DOC science project summaries 1990/1991. Science and Research Internal Report No. 117.*** **Department of Conservation, Wellington.**

Focus:
Environmental impact of camping
Natural Asset:
DoC Estate, NZ
Classification:
Physical, Vegetation, Wildlife
Activity:
Camping
Impact:
Damage/removal of vegetation , soil compaction/removal, decreased soil drainage, rubbish accumulation, water pollution, intro of pests and weeds,
Indicator:
Removal of woody vegetation and litter, absence of seedlings, decline in soil fauna, decrease in native species diversity, increased presence of weeds, presence of bare ground, damage to trees, increased soil compaction, thinned soil A horizons and loss of soil organic matter

400. **Michael Burns and Associates. 1989.** ***The environmental impacts of travel and tourism.*** **The Industries Assistance Commission: Canberra.**

Focus:
Environmental impacts of tourism

Natural Asset:
General- Australian environment
Classification:
Physical, Wildlife, Vegetation
Activity:
General including facility development, walking, land vehicle use, boating, camping, wildlife viewing, caving
Impact:
Loss of scenery, air pollution, vandalism, decreased aesthetic qualities, trampling of vegetation/shells/coral, souveniring, firewood collection, $C0_2$ pollution and graffiti in caves, track formation
Indicator:
Soil compaction, decreased vegetation cover/growth rates, wildlife habitat/ behaviour disturbance, wildlife death, presence of pathogens/pollutants, loss of nutrients

401. Ministry of Tourism 1992. *Tourism Sustainability A Discussion Paper.* Ministry of Tourism; Wellington

Focus:
Tourism sustainability, focus on people management.
Natural Asset:
Ecological systems, caves, walking tracks, wildlife breeding colonies.
Classification:
General
Activity:
General
Impact:
Damage to physical environment, disturbance of wildlife, reducing visitor experience.
Indicator:
None specified

402. Moscardo, G., Morrison, A.M. and Pearce, P.L. 1993. Specialist Accommodation and Ecologically-Sustainable Tourism. *Journal of Sustainable Tourism 4(1):29-52*

Focus:
Ecologically sustainable tourism using accommodation as a case example
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
Impacts of accommodation, waste production, energy use, degradation, disturbance and destruction of ecosystems

Indicator:
Character and benefit of specialist accommodation, ecological impacts of accommodation, energy use, waste production and pollution, disturbance

403. Mosimann, T. 1985. Geo-ecological impacts of ski piste construction in the Swiss Alps. ***Applied Geography 5:29-37.***

Focus:
Geo-ecological impacts of ski piste construction, Swiss Alps
Natural Asset:
Mountain slopes
Classification:
Physical, Wildlife, Vegetation
Activity:
Snow related activities (indirect impacts of skiing/snowboarding ie construction of ski fields)
Impact:
Increased soil erosion, decreased regeneration of vegetation
Indicator:
Geology characteristics (slope, aspects, morphology), vegetation regeneration/ resilience

404. National Industrial Pollution Control Council 1971. Land and Water Pollution from Recreational Use. U.S. Department of Commerce; Washington D.C.

Focus:
Land and water pollution from recreation
Natural Asset:
Natural/recreation areas
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Land and water pollution, general
Indicator:
None specified

405. Neumann, P.W and Merriam, H.G. 1972. Ecological effects of snowmobiles. ***The Canadian Field-Naturalist 86:207-212.***

Focus:
Ecological effects of snow mobiles
Natural Asset:
Mountain terrain and habitat
Classification:
Physical, Wildlife, Vegetation

Activity:
Snow related activities, snow mobiles
Impact:
Snow compaction increasing thermal conductivity of snow at depth, reduced temperature gradients possibly resulting in impact on fauna, change in pore space and crystal structure, increased density resulting in slower snow melt impacting on life cycle of invertebrates and microbes, damage/loss of vegetation.
Indicator:
Vegetation loss/damage, compaction, density, porosity, run-off rates, fauna composition/abundance

406. New Zealand Tourism Board and Department of Conservation. 1993. *New Zealand conservation estate and international visitors*. NZTB/ DoC, Wellington, New Zealand.

Focus:
NZ Conservation estate and international visitors
Natural Asset:
NZ Conservation estate
Classification:
Physical, Vegetation, Wildlife
Activity:
Sight seeing, wildlife viewing, photography, walking, caving,
Impact:
$C0_2$ emissions in caves damaging limestone, water pollution, waste disposal, vegetation trampling
Indicator:
None specified

407. New Zealand Tourism Board. 1997. *Stewart Island Tourism Strategy*. Wellington: New Zealand Tourism Board.

Focus:
Tourism at Stewart Island, New Zealand
Natural Asset:
Stewart Island, New Zealand
Classification:
Vegetation, Wildlife, Physical
Activity:
Walking, camping, fishing, diving, wildlife/vegetation viewing, hunting, boating (sea kayaking)
Impact:
Track erosion and bogging, wildlife disturbance, potential loss of 'character'
Indicator:
None specified

408. Nordstrom, K.F., Reinhard Lampe and Lisa M. Vandemark 2000 Reestablishing Naturally Functioning Dunes on Developed Coasts ***Environmental Management 25:37-51***

Focus:
Coastal dune management and nature based tourism
Natural Asset:
Dune ecosystems
Classification:
Physical; Vegetation; Wildlife
Activity:
Wildlife viewing; walking, land vehicle use, coastal activities general (access across dune systems), boating, diving, swimming etc
Impact:
Destruction of dune formations, loss of plant life, disturbance to wildlife, impacts of construction for accommodation, local residents, tourist facilities, mechanical cleaning of beaches destroying wildlife habitat, introduction of exotic species
Indicator:
General; changes in ecological processes/health/functioning

409. Norton, D.A. 1994. ***Application for a concession to run the Coast to Coast event through the Arthurs Pass National Park.*** **Christchurch Iron Man Productions, Christchurch.**

Focus:
Environmental and social impacts of the coast to coast endurance race (tourism event)
Natural Asset:
Arthur's Pass National Park
Classification:
Physical, Vegetation, Wildlife
Activity:
Coast to coast endurance race (tourism event including cycling, running, kayaking and support/admin)
Impact:
Track and soil damage, water logging, vegetation damage, wildlife disturbance, litter, impacts on other track users (decreased track use at time of event)
Indicator:
Changes in: track usage, vegetation/wildlife disturbance, soil compaction, stone movement

410. O'Reilly A. 1986. Tourism carrying capacity. ***Tourism Management 7(4).***

Focus:
General
Natural Asset:
General
Classification:
General

Activity:
General
Impact:
Cultural effects Economic effects Bio Physical effects (general)
Indicator:
Number of tourist arrivals per 100 local people in each region. Number of tourist nights per 100 local people in each region. Capacity of seashore in each region.

411. Organisation for Economic Cooperation and Development 1980. *The Impact of tourism on the environment.* Organisation for Economic Cooperation and Development: Paris

Focus:
Impact of tourism on the environment.
Natural Asset:
General
Classification:
Physical, Wildlife, Vegetation,
Activity:
General
Impact:
Pollution, loss of natural landscape, destruction of flora and fauna, degradation of historic sites. Social; monuments congestion, conflict, competition.
Indicator:
Economic analysis of costs/benefits, impact of environmental degradation on tourism, employment, media and advertising, use-impact relationship using time series data

412. Organisation for Economic Cooperation and Development 1994. *Environmental Indicators Indicateurs D'Environnement.* Organisation for Economic Cooperation and Development: Paris

Focus:
Environmental Indicators
Natural Asset:
Air, water, land, living resources
Classification:
Physical, Wildlife, Vegetation
Activity:
General
Impact:
Loss of naturalness and historic cultural values. Physical, chemical and biological pressures.
Indicator:
Environmental pressures, environmental conditions, societal responses

413. Opperman, M. and Chon, K-S. 1997. *Tourism in developing countries.* International Thomson, Oxford, UK.

Focus:
General tourism impacts
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General including hunting, land vehicle use, walking, camping
Impact:
Breeding disruption, killing wildlife, habitat displacement, vegetation trampling/ destruction, water/air/noise pollution, soil compaction, depletion of water supplies and fossil fuels, increased fire risk, litter, sewage
Indicator:
Change in: wildlife population, habitat location, vegetation cover/composition, pollution levels

414. Orams, M. 1999. *Marine Tourism: development, impacts and management.* Routledge: London.

Focus:
Impacts of marine tourism
Natural Asset:
General- marine environments
Classification:
Physical, Wildlife
Activity:
Boating, wildlife viewing (eg whale/seal watching), diving, snorkelling, swimming
Impact:
Wildlife damage/disturbance, coral destruction, sediment disturbance, water pollution, trampling of benthic organisms, loss of wilderness,
Indicator:
Presence of pollutants, biomass of fish, sponges, coral etc

415. Orams, M.B, 1995. Towards a more desirable form of ecotourism. *Tourism Management 16 (1): 3-8*

Focus:
Ecotourism as a factor of 'better' ecotourists and 'better' natural environment
Natural Asset:
Generic environmental impact.
Classification:
Physical, Wildlife, Vegetation
Activity:
General
Impact:
Degradation of natural and cultural environment at all classification levels and decreased quality of tourist experience.

Indicator:
Tourist: satisfaction, enjoyment, education, learning, attitude, belief change, behaviour, lifestyle change
Natural Environment: minimise disturbance, improve habitat protection, long term health and viability

416. Parliamentary Commissioner for the Environment. 1997. *Management of the Environmental Effects Associated with the Tourism Sector.* Wellington: Parliamentary Commissioner for the Environment.

Focus:
Effects of tourism on the environment and associated management, monitoring and research responses
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
Extensive range discussed, specific case studies include: tourist visits to scenic icons, caving, boating and fishing, ecotourism, campervan tours and air traffic
Impact:
Physical: protection and enhancement; air pollution; water pollution; soil erosion; soil composition and structural change; souveniring; construction damage; visual impacts.
Ecological: species conservation; wildlife disruption; loss of habitat; hunting/collecting; vegetation damage; loss of wilderness; resource pressure; spread of effects; species introduction.
Other: crowding; noise; litter; change in character; human waste; loss of landscape; loss of amenity.
Indicator:
Various. Though significance of effect a function of: the characteristics of the place where effect occurs, carrying capacity or sensitivity, mitigation measures, services required, visitor numbers, reversibility of effect

417. Parliamentary Commissioner for the Environment. 1997. *The Management of environmental effects associated with the tourism sector: review of literature on environmental effects.* Wellington: Parliamentary Commissioner for the Environment.

Focus:
Literature review of management of environmental effects associated with tourism
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
Extensive range of activities reviewed

Impact:
Physical: air pollution, water pollution, changed hydrological patterns, alterations to soil composition and structure, erosion, damage to geological features, souveniring, construction damage, diminution of visual amenity
Wildlife: disruption of breeding and feeding patterns, habitat displacement, behaviour modification and disruption, increased stress, souveniring, hunting
Vegetation: removal of vegetation cover, trampling, wetland damage, introduction of alien species, modification of species composition and age structure, increased fire risk
Indicator:
Various indicators identified, most relating to intensity and extent of use, site fragility and visitor satisfaction

418. Parliamentary Commissioner for the Environment. 1997. *The management of the environmental effects associated with the tourism sector: summary of submissions.* Wellington: Parliamentary Commissioner for the Environment.

Focus:
Summary of submissions regarding the management of the environmental effects associated with tourism
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
Various activities discussed, including those relating to infrastructure and visitor related activities
Impact:
Increased environmental protection (e.g. increased awareness or funding for protection projects)
Increased environmental degradation (examples include: habitat degeneration, soil erosion and compaction, animal disturbance, water and air pollution, soil contamination)
Indicator:
Indicators discussed in a number of submissions. Submissions discussed: existing research, data, and indicators; monitoring and implementation issues; further research requirements

419. Patmore, A. 1983. *Recreation and Resources Leisure Patterns and Leisure Places.* Basil Blackwell Publisher Ltd.; England

Focus:
Resource use for recreation.
Natural Asset:
Landscape and water resources.
Classification:
Physical, Vegetation, Wildlife
Activity:
General including walking, horse trekking etc.

Impact:
Environmental degradation varied and intense, erosion, trampling, pollution, fire, collecting specimens, hunting, disturbance.
Indicator:
Ecological carrying capacity, physical carrying capacity, social carrying capacity

420. Pearce, D.G. and Kirk, R.M. 1986. Carrying capacities for coastal tourism. ***Industry and Environment 9(1):3-7***

Focus:
Carrying capacities for coastal tourism
Natural Asset:
Coastal areas
Classification:
Physical, Wildlife, Vegetation
Activity:
Beach activities general (surfing, diving, snorkelling, swimming), boating (jet ski's, power boating, sailing, kayaking), walking (pedestrian traffic) etc
Impact:
Construction of tourist facilities, general environmental degradation; pollution, species loss/disturbance, erosion
Indicator:
None specified

421. Pigram, J.J. 1980. Environmental Implications of Tourism Development. ***Annals of Tourism Research 7(4):*** **554-583.**

Focus:
Environmental implications of tourism development
Natural Asset:
General natural environment
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Inappropriate construction/development, pollution, erosion of the resource base (wear and tear of flora, fauna and structures, vandalism, deliberate destruction or removal of natural features)
Indicator:
Redistribution of tourist flows seen as key management option

422. Pigram, J.J. and Ding, P. 1999. Tourism – Environmental Interaction: The Greening of Australian Beach Resorts. In Singh, T.V and Singh, S. *Tourism Development in Critical Environments.* Cognizant Communication Corporation; New York. Pp.35-50.

Focus:
Australian beach resorts and tourism
Natural Asset:
Coastal areas
Classification:
Physical, Wildlife, Vegetation
Activity:
Coastal activities general, water sports general, boating, walking, fishing
Impact:
Erosion, loss of wildlife, noise pollution, congestion, degradation of beaches and waterways, pressure on existing services, litter, depletion of fish and shellfish stocks, souveniring
Indicator:
Comprehensive environmental auditing; including extent and health of biology, physical structure, ecological services

423. Price MF eds. 1996 People and Tourism in Fragile Environments. Wiley; Chichester, New York

Focus:
Tourism in fragile wilderness areas and impacts on indigenous cultures.
Natural Asset:
Mountains, deserts, savannas, arctic and cultures within those.
Classification:
Wildlife, Physical, Vegetation,
Activity:
General
Impact:
Positive and negative impacts of tourism coinciding with the main food gathering seasons of indigenous peoples, short term and through time, eg. supplementing income drawing peoples away from traditional practices; improved access to areas. Loss or increase of cultural identity and cohesion. Changes in traditional practices.

Indicator:
Changes in: inherently fragile ecosystems, fragile human communities, management and decision making control

424. Rajotte, F. 1978. *A method for the evaluation of tourism impact in the Pacific.* Santa Cruz: Center for South Pacific Studies.

Focus:
Evaluating tourist impacts in the Pacific

Natural Asset:
South Pacific Islands
Classification:
Vegetation, Wildlife, Physical
Activity:
General
Impact:
General
Indicator:
Use of an evaluation matrix and decision process

425. Rembert, T.C. 1999. High Noon at Grizzly Gulch: Wise Use Groups Want to Tame the Land. Conservationists Want to Turn it Over to Wildlife. Could They Ever Agree on an Ambitious Wildlife Corridor Called Y2Y? *E: the Environment Magazine Vol* X:1.

Focus:
Yellowstone National Park, USA
Natural Asset:
Yellowstone National Park, USA
Classification:
Physical, Vegetation, Wildlife
Activity:
Hunting, fishing, wildlife viewing, land vehicle use (tourist road access), facility development, camping
Impact:
Habitat loss/displacement, behavioural disturbance, disease intro, increased fire risk, habitat fragmentation,
Indicator:
Change in mating, migration, foraging patterns and behaviours, change in habitat area

426. Rembert, T.C. 1999. Protecting Paradise: The Turks and Caicos Islands Gear Up for Responsible Ecotourism. *E: the Environment Magazine Vol X: 4.*

Focus:
Tourist development pressures in Turks and Caicos Islands
Natural Asset:
Turks and Caicos Islands
Classification:
Physical, Vegetation, Wildlife
Activity:
Facility development, fishing, boating, wildlife viewing, photography, diving, snorkelling
Impact:
Pollution, reef damage, overdevelopment, litter, pathogen introduction, wildlife disturbance and population loss
Indicator:
Reef damage, change in water quality, population change in wildlife

427. **Ritter, D. 1997. Limits of Acceptable Change Planning in the Selway-Bitterroot Wilderness: 1985 to 1997. pp. 25-28 in McCool, S.F.; Cole, D.N. (Eds) Proceedings- Limits of acceptable change and related planning processes: Progress and future directions.** ***General Technical Report INT-GTR-371.*** **Intermountain Research Station, Forest Service, U.S. Department of Agriculture.**

Focus:
LAC planning in Selway-Bitterroot Wilderness
Natural Asset:
Selway-Bitterroot Wilderness, USA
Classification:
Physical, Vegetation, Wildlife
Activity:
General including walking, camping, aircraft related activities
Impact:
Wildlife and environmental degradation, loss of wilderness character, social impacts (crowding, etc)
Indicator:
Number of campsites/square mile, number of encounters with other parties per day, use of EIA's and EISs

428. **Roberts, J. 1983. "The OECD's International Study of Tourism Impact on the Environment". Pp. 12-20 in University of Bradford.** ***The Impact of Tourism and Recreation on the Environment, Occasional Paper No. 8.*** **University of Bradford.**

Focus:
Environmental impacts of tourism
Natural Asset:
General
Classification:
Physical, Vegetation, Wildlife
Activity:
General including skiing, walking, land vehicle use, wildlife/vegetation viewing
Impact:
Air/water/noise pollution, litter, loss of natural landscape, destruction of flora and fauna

Indicator:
None specified

429. **Sage, E. 1995. Beyond the picture postcard: what tourism means for conservation.** ***Forest and Bird No 275:*** **20-31.**

Focus:
Conservation lands, high use areas; costs and benefits of tourism
Natural Asset:
Landscape, natural environment scenery

Classification:
Physical, Vegetation, Wildlife
Activity:
Walking, facilities, wildlife viewing
Impact:
Ecological; wildlife disturbance, direct destruction/damage to tracks, vegetation., habitat. Social; effects of noise, crowding, pollution, visitor behaviour, construction of facilities, educational value.
Indicator:
Cost of conservation effort, management of businesses ie. code of practice, tourism employment. Change in wildlife behaviour, site damage

430. Salm, R.V. 1986. Coral reefs and tourist carrying capacity: The Indian Ocean experience. ***Industry and Environment 9(1):11-14***

Focus:
Tourism carrying capacity on coral reefs
Natural Asset:
Coral reefs
Classification:
Physical, Wildlife, Vegetation
Activity:
Water sports general (diving, snorkelling)
Impact:
General
Indicator:
None specified

431. Shafer, Scott C. and Inglis, Graeme J. Influence of Social, Biophysical, and Managerial Conditions on Tourism Experiences Within the Great Barrier Reef World Heritage Area ***Environmental Management 26(1):73-87***

Focus:
Tourism on the great barrier reef, Australia
Natural Asset:
Great barrier reef, marine ecosystems, world heritage area
Classification:
Wildlife, Vegetation, Physical
Activity:
Boating, (including jet), water sports activities general water-skiing, swimming, snorkelling, diving, walking, wildlife viewing
Impact:
Biophysical damage; social impacts of tourism numbers
Indicator:
Comments of tourists, damage to sites, changing numbers of tourist and size of groups

432. Shelby, B. and Heberlein, T.A. 1986. *Carrying Capacity in Recreation Settings.* Oregon State University Press; Oregon.

Focus:
Carrying capacity for recreation in natural areas (USA)
Natural Asset:
Natural/wilderness areas
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General degradation from overuse
Indicator:
Ecological: percent viable ground cover, species composition, faecal coliforms, soil erosion/compaction
Physical: people per square foot in sleeping area, people per acre, camping parties per beach, number of people in critical areas
Social: encounters with others, number per camp ground/boat ramp/picnic area etc, visitor-staff ratio, waiting lists/refusals to areas

433. Shelby, B. and Harris, H. 1995. Comparing Methods for Determining Visitor Evaluations of Ecological Impacts: Site Visits. *Journal of Leisure Research, 17(1):* p.57-67.

Focus:
Lake/forest areas
Natural Asset:
Lake/forest areas in Oregon Cascades USA
Classification:
General (Wilderness and forest lakes ecosystem and landscape)
Activity:
Camping (in association with tramping, climbing, horse riding, fishing and hunting).
Impact:
Ecological and landscape impacts
Indicator:
Visitor evaluations

434. Shivlani, Manoj P. and Suman, Daniel O. Dive Operator Use Patterns in the Designated No-Take Zones of the Florida Keys National Marine Sanctuary (FKNMS) *Environmental Management 25:647-659*

Focus:
Dive operators use patterns in no-take marine reserve zones
Natural Asset:
Florida keys marine reserve zones
Classification:
Physical, Wildlife
Activity:
Water sports general (diving, snorkelling), wildlife viewing

Impact:
Damage/destruction of coral reefs/marine flora, illegal fishing, wildlife disturbance, water pollution
Indicator:
None specified

435. Simmons, D.G. 1990. Recreation and Tourism. Pp 296-297 in Towns, D.R., Daugherty, C.H. and Atkinson, I.A.E. (Eds) *Ecological Restoration of New Zealand Islands*. Conservation Sciences, Publication N° 2. Department of Conservation, Wellington.

Focus:
Limits of Acceptable Change (LAC) using ROS. On islands
Natural Asset:
Island (conservation)
Classification:
General (Island environments)
Activity:
General: island trips, and water based recreation
Impact:
N/A
Indicator:
Recommended a case study test of LAC for island management

436. Simpson, P. and Wall, G. 1999. Environmental impact assessment for tourism: a discussion and an Indonesian example. Pp 232-256 in Pearce, D.G. and Butler, R.W. (Eds). *Tourism development: contemporary issues.* New York: Routledge.

Focus:
EIA's and assessing the impacts of tourism
Natural Asset:
General
Classification:
Vegetation, Wildlife, Physical
Activity:
General- focus on tourism development and the resulting rise in tourist services (roads, taxis, flights, restaurants) and attractions

Impact:
Argues that impacts are diverse and context specific and can't be generalised. Suggests that economic, environmental and social impacts shouldn't be separated. Cumulative impacts of small activities often as bad as large ones.
Indicator:
Advocates EIA (example given of waste or emission concentration levels as one component of the EIA)

437. Singh, T.V. and Singh, S. 1999. Coastal Tourism, Conservation, and the Community: Case of Goa. In Singh, T.V and Singh, S. *Tourism Development in Critical Environments.* Cognizant Communication Corporation; New York. Pp.65-76.

Focus:
Coastal tourism, conservation and community
Natural Asset:
Coastal tourism, Goa, India
Classification:
Physical, Vegetation, Wildlife
Activity:
Coastal activities general including swimming, walking, boating, accommodation, facilities
Impact:
Impacts of construction of facilities (soil compaction, increased pressure on existing infrastructure, vegetation loss, habitat modification), increased pollution, over fishing/shellfish collection, increased litter
Indicator:
None specified

438. Spellerberg, I.F and Morrison, T. 1998. The ecological effects of new roads – a literature review. *Science for Conservation 84,* Department of Conservation, Wellington

Focus:
Ecological effects of new roads
Natural Asset:
Natural environment, habitats, protected areas in NZ
Classification:
Physical, Vegetation, Wildlife
Activity:
Land vehicle use
(increased tourism numbers increase pressure to existing roads requiring upgrades or new roading)
Impact:
Soil erosion, changes to bank and soil stability, alteration to surface water hydrology, changes to sediment flow, pollutants to ecosystems, surface and ground water and air ($C0_2$, NO_x heavy metals, Pb lead, Cd cadmium, Zn zinc, Ni nickel), introduced weeds and animal pests, decreased health and resilience of biota on road verges (edge effects), physical disturbance, habitat loss, wildlife disturbance, displacement and death (during and post construction), habitat fragmentation, change to species composition, loss of old-growth forest, lower resilience of habitat, increased noise
Indicator:
Physical: erosion, slope and soil stability, drainage/flow patterns and changes, pollutants, changes to natural chemical residues
Wildlife: displacement, disturbance, behavioural changes, death, population dynamics, species composition, predation
Vegetation: loss, composition change, fragmentation, attrition/dye back, browse from predators

439. Spencer, H.J., Scott, N.E., Port, G.R., and Davison, A.W. 1988 Effects of roadside conditions on plants and insects. I. Atmospheric conditions. ***Journal of Applied Ecology 25:699-707.***

Focus:
Effects of roadside conditions on plants, insects and soil
Natural Asset:
Ecosystems adjacent to roadsides
Classification:
Wildlife, Vegetation, Physical
Activity:
Land vehicle use (driving, transport)
Impact:
Fewer plants geminated in roadside soil closer to roadside comparative to sites further from the roadside, plants close to roadway attained higher dry weight and greater soluble nitrogen content, aphids grew more rapidly with higher fecundity on plants close to roadside
Indicator:
Vegetation growth rates, insect population changes and growth rates, chemical soil changes

440. Splettstoesser, J. 1999. Antarctica Tourism: Successful Management of a Vulnerable Environment. In Singh, T.V and Singh, S. ***Tourism Development in Critical Environments.*** **Cognizant Communication Corporation; New York. Pp.137-148**

Focus:
Managing tourism in Antarctica
Natural Asset:
Antarctica
Classification:
Physical, Wildlife, Vegetation
Activity:
Wildlife viewing, boating (cruise ships), aircraft related viewing
Impact:
General
Indicator:
None specified

441. Splettstoesser, J. and Folks, M.C. 1994. Environmental Guidelines for Tourism in Antarctica. ***Annals of Tourism Research 21 (2):231-244***

Focus:
Environmental guidelines for tourism in Antarctica
Natural Asset:
Ice continent
Classification:
Physical, Wildlife
Activity:
Boating (cruise ships), aircraft related activities, 'adventure tourism' including overland travel, mountaineering.

Impact:
Wildlife disturbance, physical damage and pollution
Indicator:
Non-specific, wildlife disturbance, physical damage and pollution

442. Springer, K. 1993. *Otago Conservancy Recreation Strategy.* Miscellaneous Series N° 18. Department of Conservation, Dunedin.

Focus:
Recreational opportunities in Otago Conservancy
Natural Asset:
Otago Conservancy
Classification:
General (coastal; lowland forest; semi-arid valleys, mountain ranges; Alps; lakes)
Activity:
Various
Impact:
Recreation conflict; Activity versus setting; Roading; Off-road vehicles; Access to recreation; Other recreation; Safety
Indicator:
Suggests collate: visitor numbers, traits, origins, wants, and dis/satisfaction; identify surplus/needed facilities, information needs, effects of recreationalists; and track degradation and overcrowding.

443. Stankey, G.H., Cole, D.N., Lucas, R.C., Petersen, M.E. and Frissell, S.S. 1985. *The Limits of Acceptable Change (LAC) System for Wilderness Planning.* General Technical Report INT-176. U.S.D.A. Forest Service. Intermountain Forest and Range Experiment Station.

Focus:
LAC for Wilderness planning
Natural Asset:
Wilderness areas in the USA
Classification:
General
Activity:
General
Impact:
General
Indicator:
Trail/campsite conditions, water/air quality, wildlife populations, threatened/ endangered species, solitude, noise, conflict

444. Stankey, G.H and McCool, S.F. 1991. Recreation Use Limits: The Wildland Manager's Continuing Dilemma. *Western Wildlands A Natural Resource Journal 16(4):2-7*

Focus:
Use-limit policies for recreation in wilderness areas.

Natural Asset:
American wildlands, landscape, wildlife, rivers.
Classification:
Wildlife, Physical, Vegetation
Activity:
General; walking, rafting
Impact:
Social; crowding; Ecological; general degradation
Indicator:
Use-impact ie. relationship between use and impact, use levels, economic efficiencies in use levels

445. Stephenson, P.J. 1993. The impacts of tourism on nature reserves in Madagascar: Perinet, a case study. ***Environmental Conservation 20 (2):*** **262-265.**

Focus:
Ecological effects of ecotourism.
Natural Asset:
Nature reserves (especially Perinet reserve), Madagascar
Classification:
Physical, Wildlife, Vegetation
Activity:
Wildlife/vegetation viewing, photography, nature tours
Impact:
Habitat disturbance, wildlife disruption, socio-economic disruption to local villages who fail to benefit from tourism, path erosion, littering, potential decline in wildlife populations.
Indicator:
Presence of trampled vegetation, species population changes, involvement of locals in tourist service provision, existence of tourist infrastructure (e.g. interpretation sites, facilities, tracks)

446. Stephenson, G. 1999. Vehicle impacts on the biota of sandy beaches and coastal dunes. ***Science for Conservation, No. 121.*** **Department of Conservation, Wellington. 50p.**

Focus:
Coastal
Natural Asset:
Biota of coastal sand beaches and dunes
Classification:
Wildlife, Vegetation (coastal)
Activity:
Land vehicle use (off-road vehicles, access to attractions)
Impact:
Ecological, direct destruction/damage to vegetation and wildlife, habitat disturbance

Indicator:
Change in population numbers and density, soil compaction, nesting patterns, species composition, crushed vegetation/wildlife

447. Stewart, M.C. 1993. Sustainable tourism development and marine conservation regimes. *Ocean and Coastal Management 20:* 201-217.

Focus:
Marine conservation regimes as a means of managing tourism
Natural Asset:
Marine and coastal natural assets
Classification:
Vegetation, Wildlife, Physical (marine/coastal)
Activity:
Marine/coastal activities general including boating, swimming, hunting, fishing, walking, development
Impact:
Various include- vegetation loss, erosion, track widening, coral reef damage, animal disturbance, aesthetic degradation, water pollution, nutrification, litter, anchor damage, souveniring,
Indicator:
None specified

448. Stonich, S.C. 2000. *The Other Side of Paradise: Tourism, Conservation and Development in the Bay Islands*. New York: Cognizant.

Focus:
Tourism impacts in the Bay Islands, Honduras
Natural Asset:
Bay Islands, Honduras
Classification:
Vegetation, Wildlife, Physical
Activity:
Facility development, boating, diving, fishing,
Impact:
Erosion, loss of landscape values, increased sewage outfall, decreased freshwater supplies, water pollution, reef destruction, wildlife habitat destruction
Indicator:
Change in percentage of dead or dying reef, pollutant concentrations in water

449. Tabata, R.S. 1991. Dive Travel: Implications for Resource Management and Tourism Development. Pp. 677-693 in Kusler, J.A. (Ed) *Ecotourism and Resource Conservation, Vol 2.* Madison: Ecotourism and Resource Conservation Project.

Focus:
Impacts of diving
Natural Asset:
General underwater resources

Classification:
Physical, Wildlife, Vegetation
Activity:
Scuba diving, snorkelling
Impact:
Water pollution, increased freshwater runoff, litter, siltation, anchor damage, trampling, specimen collecting
Indicator:
Changes in the diversity of marine life, water quality, damage to geological or coral formations

450. Tarrant M.A., and Schafer, C.S. 1997 Condition Indicators for Distinct Wilderness Is there Uniformity? *International Journal of Wilderness 3(4):29-33.*

Focus:
Uniformity of indicators for wilderness impact.
Natural Asset:
Landscape
Classification:
Physical, Vegetation, Wildlife
Activity:
Camping, walking
Impact:
Litter, vegetation loss/damage, track degradation.
Indicator:
Vegetation damage, rubbish, opportunities to view wildlife

451. Todd, S.E and Williams P.W. 1996. From White to Green: A Proposed Environmental Management System Framework for Ski Areas. *Journal of Sustainable Tourism 4(3):147-173*

Focus:
EMS system for managing environmental impacts of ski fields Canada
Natural Asset:
Ski fields and environs
Classification:
Physical, Wildlife, Vegetation
Activity:
Skiing, Snowboarding
Impact:
Changes in water quality, pollution (sewage, fuel, litter), slope stability, air quality, damage/trampling to ecosystem, increased energy use, wildlife disturbance
Indicator:
Management practices, changes in environmental quality, tourist satisfaction, infrastructure capability, environmental education level of tourists

452. Turner J.M. 2000. Path of Destruction: The Limits of "Leave no trace". *E: the Environment Magazine Vol XI: 3.*

Focus:
Recreation threats to wilderness
Natural Asset:
United States wilderness areas
Classification:
Physical, Vegetation, Wildlife
Activity:
Walking, camping
Impact:
Vegetation/physical damage, litter, increased fire risk, uncontrolled campsite expansion
Indicator:
Presence of litter/waste/camping products, change in campsite area

453. Tyson, B. 1989. *Limits of Acceptable Change (LAC): An evaluation of the concept for introduction as a Department of Conservation resource planning technique.* Unpublished internal report, Head Office, Department of Conservation, Wellington.

Focus:
Limits of Acceptable Change
Natural Asset:
National and forest parks
Classification:
General
Activity:
Skiing, walking, camping
Impact:
Overcrowding, erosion, incompatible activities
Indicator:
Seeks indicators: Biological: plant and wildlife; Physical: soil, water, air; Human: type/traits, activity, number, locations, times; demand/supply; benefits/values

454. United States Environmental Protection Agency. June 8, 2000. *Economic and Environmental Impacts of Travel, Tourism and Recreation in the US: Developing a Quantitative Model.* USA: United States EPA. Retrieved December 8, 2000 from the World Wide Web: http://www.epa.gov/opispdwb/define.htm.

Focus:
Economic and environmental impacts of tourism in the US
Natural Asset:
Tourism assets in the USA
Classification:
Physical, Vegetation, Wildlife
Activity:
General including boating, hunting, skiing, snowboarding, golfing, waterside activities, fishing

Impact:
Various- no specifics given
Indicator:
Water use, energy use, air emissions (carbon monoxide, NOx, and hydrocarbons), solid waste generation, waste-water generation, greenhouse gas emissions. These indicators are used alone and in combination with other subsector-specific data such as participation rates

455. United States Environmental Protection Agency. 2000. *Coastal Tourism*. USA: United States EPA. Retrieved December 8, 2000 from the World Wide Web: http://www.epa.gov/owowwtr1/oceans/yoto/oceanrpt/cotour.html.

Focus:
Coastal tourism
Natural Asset:
Coastal tourism assets in the USA
Classification:
Physical
Activity:
Coastal activities general including boating, fishing, swimming, walking, diving,
Impact:
Water quality degradation and pollution, habitat destruction, excessive development
Indicator:
None specified

456. University of Bristol. 1991. *Berwick upon Tweed. A Strategy for Sustainable Rural Tourism*. The Rural Tourism Development Project. Department for Continuing Education, University of Bristol; England.

Focus:
Strategy for rural tourism
Natural Asset:
Rural areas of Berwick Borough Council, Upland coastal ecosystems
Classification:
Wildlife, Vegetation, Physical
Activity:
Walking, sight seeing, caravanning, camping
Impact:
Degradation of upland and coastal ecosystems; general
Indicator:
None specified

457. Wall, G. and Wright, C. 1977. *The Environmental Impact of Outdoor Recreation.* Ontario: Department of Geography, University of Waterloo.

Focus:
Environmental impact of outdoor recreation
Natural Asset:
General- including geology, soil, vegetation, water, wildlife and air
Classification:
Physical, Vegetation, Wildlife (including geology, soil, vegetation, water, wildlife and air)
Activity:
General including camping, walking, climbing, snowmobiles, swimming, boating
Impact:
Extensive list of impacts specific to each environment type/asset
Indicator:
Extensive list of indicators specific to each environment type/asset

458. Wall, G. 1997. Is Ecotourism Sustainable? *Environmental Management 21:483-491*

Focus:
Contribution of tourism to sustainable development (including Ecological/ economic/social etc)
Natural Asset:
General
Classification:
General
Activity:
General
Impact:
General
Indicator:
None specified

459. Wang, C.-Y.; Miko, P.S. 1997. Environmental impacts of tourism on U.S. national parks. *Journal of Travel Research.* Spring1997: 31-36.

Focus:
Environmental impacts of tourism on US national parks
Natural Asset:
US national parks
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
Degraded water quality from boating, consumption, waste water disposal. Air and noise pollution. Weed intro, plant theft/trampling, fire. Wildlife impacts include disruption from photography, traffic, littering. Coastline/shore degradation from construction, removal of shells etc, and interference with breeding.

Indicator:
None identified

460. Ward, J.C. and Beanland, R.A. 1994. *Development of Environmental Indicators for Tourism in Natural Areas: A Preliminary Study* Lincoln Environmental; Canterbury

Focus:
Environmental Indicators for Tourism
Natural Asset:
General
Classification:
Physical, Wildlife, Vegetation
Activity:
General
Impact:
Generic impacts; damage to natural feature, habitat degradation, changes in animal behaviour, reduced biodiversity, soil erosion and compaction, pollution (sewage disposal, discharges to air, solid waste disposal and litter), noise from aircraft, boat and traffic, aesthetic changes from structures and crowding.
Indicator:
Vegetation: area degraded, change in species composition and community structure, % cover of introduced weeds, cumulative use of site, soil type, slope, climate
Erosion: % bare ground, area affected, slope, aspect, soil type
Wildlife: loss of habitat, food supply, change in feeding patterns, breeding success, effect on productivity resulting from disturbance of essential functions, severe exertion, displacement, death. Biodiversity: Species numbers and composition, population levels
Pollution: faecal coliforms, giardia, erosion and sedimentation, flow and dilution rates, nutrient enrichment, sewage discharge, waste produced, litter collected
Natural features: type of damage, area affected

461. Ward, J.C. and Beanland, R.A. 1995. Development of environmental indicators for tourism in natural areas: A preliminary study. *Information Paper No 53.* Centre for Resource Management/Lincoln Environmental, Lincoln University.

Focus:
Development of environmental indicators for tourism
Natural Asset:
Various NZ natural assets
Classification:
General
Activity:
General including walking, boating, aircraft related tours, wildlife viewing, walking, mountaineering, climbing, camping, skiing, fishing, biking

Impact:
Damage to natural features, habitat degradation, wildlife behavioural change, decreased biodiversity, soil erosion and compaction, pollution (various types), noise, aesthetic (structures and crowding)
Indicator:
Carrying capacity (including ROS, LAC, UET, VIM)

462. Ward, J.C. and Beanland, R.A. 1995. Biophysical Impacts of Tourism. *Information Paper No. 56.* Lincoln Environmental and Centre for Resource Management. Lincoln University, Canterbury, New Zealand. 76p.

Focus:
Biophysical impacts of tourism, New Zealand
Natural Asset:
Various case studies (12) in New Zealand
Classification:
Vegetation, Wildlife, Physical
Activity:
General including walking, land vehicle use, camping, climbing, wildlife viewing, boating, water recreation
Impact:
Vegetation/habitat degradation, soil erosion/compaction, damage to natural features, wildlife disturbance to behaviour and breeding, habitat alteration, degraded water quality, contaminated soil, air pollution, noise pollution, decreased in amenity values
Indicator:
Various -includes: wildlife behavioural changes, vegetation/physical damage, species numbers/abundance, soil and vegetation characteristics

463. Ward, M.B. 1993. *Perceptions of Crowding in a National Park Setting: Tongariro National Park.* Unpublished MA Thesis, Auckland University, Auckland.

Focus:
Social carrying capacity, drawing on crowding and social norms theories
Natural Asset:
Tongariro National Park
Classification:
General (active volcanoes covered in lowland podocarp and beech forest, tussock shrublands and alpine desert)
Activity:
Various (skiing; walking; hunting; swimming; camping; alpine climbing)
Impact:
Crowding
Indicator:
Perceptions, social norms, attitudes

464. Warnken J. and Buckley R. Monitoring Diffuse Impacts: Australian Tourism Developments *Environmental Management 25(4):453-461*

Focus:
Monitoring diffuse environmental impacts of tourism
Natural Asset:
Natural areas inclusive used for tourism in Australia
Classification:
Wildlife; Vegetation; Physical
Activity:
General
Impact:
General environmental degradation over a long period or spread over large areas often going undetected
Indicator:
Various - includes: wildlife population/behavioural changes, vegetation changes, soil characteristics

465. Warren, G.A. 1997. Recreation management in the Bob Marshall, Great Bear, and Scapegoat Wildernesses: 1987 to 1997. pp. 21-24 in McCool, S.F.; Cole, D.N. (Eds) Proceedings- Limits of acceptable change and related planning processes: Progress and future directions. *General Technical Report INT-GTR-371.* Intermountain Research Station, Forest Service, U.S. Department of Agriculture.

Focus:
Wilderness recreation management
Natural Asset:
Bob Marshall Wilderness Complex, Montana USA
Classification:
General
Activity:
General- including: walking, camping, rafting, aircraft access to the complex
Impact:
Non specific "degradation to vegetation, soil, water, fish and wildlife resources"
Indicator:
Social surveys, trail conditions, resource standards (number of human impacted sites, litter occurrence, experience quality, forage utilisation)

466. Warren, J.A.N and Taylor, N. 1994. *Developing Eco-tourism in New Zealand.* New Zealand Institute for Social Research and Development Ltd; Wellington

Focus:
Developing eco-tourism in NZ
Natural Asset:
General
Classification:
General

Activity:
General
Impact:
Non-specific, general
Indicator:
Evidence of infrastructure and level of management

467. Watson, A., Bayfield, N., and Moyes, S.M. 1970. Research on human pressures on Scottish tundra, soil and animals. In Fuller, W.A. and Kevan, P.G. (Eds.): Productivity and conservation in northern circumpolar lands. ***New Series 16: 256-266.***

Focus:
Human impacts on tundra, soil and animals in ski field areas
Natural Asset:
Ski field terrain
Classification:
Physical, Vegetation, Wildlife
Activity:
Skiing and related activities (eg. roads, ski lifts, grooming, grading)
Impact:
Soil erosion, vegetation damage and loss, wildlife disturbance, changes in thermal conductivity affecting frost and thaw
Indicator:
Changes in vegetation abundance and diversity, thermal conductivity, compaction/density, percentage bare ground

468. Weiler, B. 1993. Nature-based tour operators – are they environmentally friendly or are they faking it? ***Tourism Recreation Research 18(1):*** **55-60.**

Focus:
Eco-tourism
Natural Asset:
Various
Classification:
General
Activity:
General
Impact:
Various
Indicator:
Visitor perceptions, based on survey results

469. Wendt, C.W. 1991. Providing the Human and Physical Infrastructure for Regulating Ecotourism Use of Protected Areas. Pp. 520-528 in Kusler, J.A. (Ed) *Ecotourism and Resource Conservation, Vol 2.* Madison: Ecotourism and Resource Conservation Project.

Focus:
Infrastructure needs for ecotourism in protected areas
Natural Asset:
Protected natural areas in North America
Classification:
Vegetation, Wildlife, Physical
Activity:
Camping, walking, climbing, boating, fishing, horse treks, skiing
Impact:
Multiple tracking, erosion, litter, overdevelopment, vegetation loss,
Indicator:
None specified

470. Whareaitu, T., 1992. Statutory Provisions Enabling Maori to Influence Marine Conservation and Wildlife Protection *in Marine Conservation and Wildlife Protection Conference Proceedings;* New Zealand Conservation Authority Te Whakahaere Matua Atawhai o Aotearoa; Wellington

Focus:
Statutory provisions enabling Maori to influence marine conservation and wildlife protection.
Natural Asset:
Marine, Fresh water, geothermal energy, minerals, forests, land.
Classification:
Wildlife, Physical, Vegetation (marine)
Activity:
Non-specific
Impact:
Cultural and physical pollution. Loss of rangatiratanga, resulting in lessened or no access and appropriate management of to kaimoana, taiapure.
Indicator:
Statutory processes relating to Maori, degree of rangatiratanga.

471. Whelan, T. ed. 1991. *Nature Tourism Managing for the Environment.* Island Press; Washington

Focus:
Ecotourism
Natural Asset:
General, natural environment, private and public
Classification:
Physical, Wildlife, Vegetation,
Activity:
General, non-specific, wildlife viewing, walking.

Impact:
General; damage to ecology of areas, wildlife death; cultural lifestyle impact specifically on indigenous peoples.
Indicator:
Management activities, involvement and changes to local communities, environmental degradation, tourist experience and educative value

472. Whisman, S.A. and Hollenhorst, S.J. 1998. A Path Model of Whitewater Boating Satisfaction on the Cheat River of West Virginia *Environmental Management 22:109-117*

Focus:
Whitewater use for recreation, visitor satisfaction, Cheat River USA
Natural Asset:
Freshwater river systems
Classification:
Physical, Wildlife
Activity:
Boating (jet boats/jet skis, rafting, kayaking), swimming, fishing
Impact:
Wildlife disturbance, turbidity, litter, pollution, over crowding, riparian flora destruction
Indicator:
None specified

473. Wight, Pamela A. 1993 SUSTAINABLE ECOTOURISM: Balancing Economic, Environmental and Social Goals, Publisher unknown

Focus:
Sustainable tourism goals
Natural Asset:
Natural/rural areas
Classification:
Wildlife, Vegetation, Physical
Activity:
General
Impact:
General, inclusive
Indicator:
None specified

474. Wilkinson, P.F. 1989. Strategies for tourism in island microstates. *Annals of Tourism Research 16:* **153-177.**

Focus:
Tourism in island microstates
Natural Asset:
Island microstates

Classification:
Physical, Vegetation, Wildlife
Activity:
General including facility development, diving snorkelling, boating, souveniring
Impact:
Erosion, pollution, physical damage (e.g coral loss/change), water contamination
Indicator:
None specified

475. **Williams, P.W. 1987. Evaluating environmental impact and physical carrying capacity in tourism. In J.R.B. Ritchie and C.R. Goeldner (eds.), *Travel, tourism and hospitality research. A handbook for managers and researchers* pp.385-397**

Focus:
Evaluating environmental impacts of tourism
Natural Asset:
Natural areas
Classification:
Physical, Vegetation, Wildlife
Activity:
General
Impact:
General, inclusive
Indicator:
None specified

476. **Williams, P.W. and Gill, A. 1999. A Workable Alternative to the Concept of Carrying Capacity: Growth Management Planning. In Singh, T.V and Singh, S. *Tourism Development in Critical Environments.* Cognizant Communication Corporation; New York. Pp.51-64**

Focus:
Alternative to carrying capacity for increased tourism numbers in natural environments
Natural Asset:
Focuses on mountain environments
Classification:
Physical, Vegetation, Wildlife
Activity:
Snow related activities, mountaineering, skiing, snow mobiles etc

Impact:
General, inclusive
Indicator:
None specified

477. Wilson, D. 1997. "Strategies for Sustainability: Lessons from Goa and the Seychelles". Pp 173-197 in Stabler, M.J. *Tourism and Sustainability.* New York: CAB International.

Focus:
Tourism impacts in Goa and the Seychelles
Natural Asset:
Goa and the Seychelles
Classification:
Vegetation, Wildlife, Physical
Activity:
General including facility development, boating (cruise ships), water sports general including diving, snorkelling, swimming, walking, wildlife viewing,
Impact:
Overdevelopment, depletion of freshwater supplies, salination, dune erosion, water pollution, garbage dumping, sand removal
Indicator:
None specified

478. WTO, UNEP, IUCN. 1992. *Guidelines: Development of National Parks and Protected Areas for Tourism.* World Trade Organisation; Madrid

Focus:
Development of National Parks for Tourism
Natural Asset:
Global natural areas
Classification:
Vegetation, Physical, Wildlife
Activity:
General
Impact:
Wildlife disturbance, habituation of wildlife, behavioural changes, wildlife mortality, soil and vegetation damage, souvenir collection, vegetation loss and habitat destruction through firewood collection, introduction of weeds/pests, habitat change/community structure change, over-development of facilities/local residents, pollution, water quality decreased, litter
Indicator:
General

Key Word Index