DEVELOPMENT OF ENVIRONMENTAL INDICATORS

FOR TOURISM IN NATURAL AREAS:

A Preliminary Study

Jonet C Ward
Lincoln Environmental
Lincoln University

Ruth A Beanland
Planning Department
Massey University

Centre for Resource Management/Lincoln Environmental

May 1995

Information Paper No 53
Lincoln Environmental is a research, consulting and teaching organisation based at Lincoln University. Research is focused on the development of conceptually sound methods for resource use that may lead to a sustainable future. Lincoln Environmental acknowledges the financial support received from the Ministry of Commerce in the production of this Paper. Lincoln Environmental offers staff the freedom of enquiry. Therefore, the views expressed in this Paper are those of the authors and do not necessarily reflect those of the organisation.

In the role of the Government’s policy advisor on tourism, the Ministry of Commerce is committed to the sustainable development of New Zealand as a visitor destination. The challenge is to obtain the benefits from visitor growth while effectively managing the increased demands this growth places on host communities and the environment.

This work was commissioned by the Tourism Policy Group of the Ministry of Commerce to provide input into internal policy development.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>1</td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Purpose and Scope of this Paper</td>
<td>2</td>
</tr>
<tr>
<td>2 BACKGROUND</td>
<td>3</td>
</tr>
<tr>
<td>2.1 Visitor Impacts and Carrying Capacity</td>
<td>3</td>
</tr>
<tr>
<td>2.3 NZ - Monitoring/Surveying of Visitor Impacts Carried Out to Date</td>
<td>5</td>
</tr>
<tr>
<td>3 NATURAL ATTRACTIONS</td>
<td>11</td>
</tr>
<tr>
<td>3.1 Background</td>
<td>11</td>
</tr>
<tr>
<td>3.2 Categories of Natural Attractions in New Zealand</td>
<td>13</td>
</tr>
<tr>
<td>4 VISITOR IMPACTS ON THE ENVIRONMENT</td>
<td>15</td>
</tr>
<tr>
<td>5 MANAGEMENT FRAMEWORK</td>
<td>17</td>
</tr>
<tr>
<td>5.1 Background</td>
<td>17</td>
</tr>
<tr>
<td>5.2 Conservation Act 1987</td>
<td>17</td>
</tr>
<tr>
<td>5.3 Resource Management Act 1991</td>
<td>18</td>
</tr>
<tr>
<td>5.4 Local Government Act 1974</td>
<td>18</td>
</tr>
<tr>
<td>5.5 Implications for the Development of Environmental Indicators</td>
<td>19</td>
</tr>
<tr>
<td>6 DEVELOPMENT OF ENVIRONMENTAL INDICATORS</td>
<td>21</td>
</tr>
<tr>
<td>6.1 Monitoring and the Use of Indicators</td>
<td>21</td>
</tr>
<tr>
<td>6.2 The Development of Indicators</td>
<td>22</td>
</tr>
<tr>
<td>6.3 Information Requirements to Identify Indicators</td>
<td>23</td>
</tr>
<tr>
<td>6.4 Management Information</td>
<td>26</td>
</tr>
<tr>
<td>7 CASE STUDIES</td>
<td>29</td>
</tr>
<tr>
<td>8 CONCLUSIONS AND RECOMMENDATIONS</td>
<td>33</td>
</tr>
<tr>
<td>8.1 Where To From Here?</td>
<td>35</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>37</td>
</tr>
</tbody>
</table>
LIST OF APPENDICES:

Appendix A: Project Methodology ........................................................................................ 41
Appendix B: Initial Contact List ........................................................................................... 43
Appendix C: Letter to Contact Agencies .............................................................................. 45
Appendix D: Examples of Natural Attractions in New Zealand by Category ......................... 47
Appendix E: Tables 1 to 3 .................................................................................................... 49

LIST OF TABLES:

Table 2.1: Implementation of the carrying capacity concept - guidelines .................. 4
Table 2.2: Summary of replies from DoC conservancies on monitoring/surveying of visitor impacts ........................................................................................................... 6
Table 2.3: Summary of replies from Regional and District Councils on monitoring/ surveying of visitor impacts ................................................................. 9
Table 3.1: Categories of natural attractions in NZ .......................................................... 14
Table 4.1: Generic environmental impacts ........................................................................ 15
Table 6.1: Development of indicators from potential environmental impacts .................. 24
Table 6.2: Management information required to develop indicators .............................. 27

LIST OF FIGURES:

Figure 3.1: Major attractions and tramping racks on the conservation estate (NZ Tourism Board & DoC, 1993) ................................................................. 12
Figure 3.2: Activities undertaken by visitors (NZ Tourism Board, 1993) ....................... 13
Figure 5.1: Conservation management framework - example ....................................... 18
Figure 6.1: Ecological effects of tramping (Wall & Wright, 1977) .................................. 25
Figure 6.2: Impacts of recreation on wildlife (Kuss et al, 1990) ...................................... 26
Figure 6.3: Recreational impact inter-relationships (Wall & Wright, 1977) ..................... 27
ACKNOWLEDGEMENTS

We would like to thank Robert Sowman (Tourism Policy Group of the Ministry of Commerce) for his advice and the financial support of the Ministry of Commerce in the preparation of this Information Paper. We also thank the following people for the assistance they have given us through discussion and reference material:

- Andrew Bignall (DoC Head Office, Wellington)
- Kay Booth (Lincoln University)
- Ross Corbett (DoC, Christchurch)
- David Given (Lincoln University)
- Ken Hugy (DoC, Christchurch)
- Colin Miscelly (DoC, Wellington)
- David Norton (University of Canterbury)
- Poma Palmer (DoC, Christchurch)
- Chris Robertson (DoC Science & Research Division, Wellington)
- Johanna Rosier (Massey University)
- David Simmons (Lincoln University)
- Steve Sutton (DoC, Auckland)

and all those who have responded to our questionnaire.
1 INTRODUCTION

1.1 Introduction

Tourism is both a major contributor to global, regional and local economies and a contributor to human stress on the environment. It can provide an economic justification for conservation and, by enabling people to enjoy protected areas and diverse environments, tourism can promote public awareness and support for the conservation of natural areas and attractions. However, when uncontrolled or overdeveloped, tourism can endanger natural resources, cause visual or cultural pollution, and destroy the very resource on which it is based (Simmons, 1990).

The growth of "eco" or "nature" tourism worldwide suggests that recreation and tourism in natural areas will increase in importance in future years (Booth, 1993). The New Zealand Tourism Board aims to achieve three million visitors per year by the year 2000, much of this by marketing New Zealand's "clean, green image", in order to capitalise on growing interest and awareness of the environment (Tourism Board, 1994).

However, the long term future of the New Zealand tourism industry is closely linked to sustainable management of the environmental qualities that make this country a unique tourism destination. "Sustainable tourism means achieving growth in a manner that does not deplete the resource, cheat the visitor, or exploit the local population. It means New Zealand's natural and physical resources should be used but not depleted, and any build-up of negative effects and irreversible damage should be prevented" (Ministry of Tourism, 1992, p1).

Loss of the attributes which make a site or region attractive to tourists can spell economic disaster to the industry and those who depend on it. The long term viability of the tourist industry in New Zealand is dependent upon the maintenance of the quality of our natural environment. Unless the tourist industry has an understanding of the impacts of its actions on the environment, then it risks its own future stability. Yet mechanisms have not yet been put in place to thoroughly evaluate the environmental consequences of visitors to natural areas and natural attractions (Manning, 1992; Whelan, 1991).

Better information is needed to aid decision-makers to deal with the concept and implementation of sustainable tourism. Clear indicators are required which provide information on:

- The links between the tourism industry and the natural and cultural environment;
- The effects of environmental factors on the tourism industry; and
- The impacts of the tourism industry on the environment.

The Tourism Policy Group (formerly the Ministry of Tourism) is currently undertaking a number of projects aimed at achieving sustainable tourism, including this particular project which involves the development of "environmental indicators for tourism in natural areas".

Information Paper No 53
1.2 Purpose and Scope of this Paper

The purpose of this Paper is:

i. To identify the ecosystems and natural attractions of significance to tourism.

ii. To identify the potential impacts of visitors on these ecosystems and natural attractions.

iii. To identify monitoring/surveying of visitor impacts carried out to date.

iv. To identify the information gaps in relation to visitor impacts on natural attractions in New Zealand.

v. To provide a framework for the development of environmental indicators of visitor impacts on natural attractions.

vi. To test this framework in relation to a small number of case studies.

vii. To make recommendations:

• For a national policy perspective on the development and monitoring of visitor impacts on natural areas;
• Further work required in this area; and
• An approach for proceeding with the development of environmental indicators of visitor impacts on natural areas.

A review of the relevant literature showed that for the purpose of developing indicators, there is a need to focus on visitors to particular natural attractions rather than restrict consideration to tourists per se, types of ecosystems or types of areas, such as Conservation Estate (Booth, 1993; Collier, 1989; New Zealand Tourism Board and the Department of Conservation, 1993; Simmons, 1990).

In this context, a natural attraction is a “product” which has specific features, amenity and/or accessibility to which people are attracted, and includes those natural areas or features with:

• High amenity value/scenic beauty;
• Significant landscape, habitat, flora and fauna or cultural interest; and
• The ability to provide particular experiences.

The literature highlighted the need to look at the wider issues associated with the impacts of all types of visitors and all types of activities in relation to these natural attractions.

This Paper will therefore use the term visitor to include all international and domestic tourists and recreationists who go to a particular natural attraction for a particular experience.

It should be noted that this Paper focuses on the ecological impacts of visitors on natural areas and natural attractions. The social, cultural and economic impacts also need further examination and appropriate indicators developed, however this was beyond the scope of this particular project and is something that should be provided for in future work. It is essential that the development of indicators for social, economic and social impacts be integrated with the development of environmental indicators.

The Project Methodology is outlined in Appendix A.
2 BACKGROUND

2.1 Visitor Impacts and Carrying Capacity

From the review of relevant literature, it is apparent that research undertaken in relation to visitor impacts has focused on attempting to establish recreational carrying capacities.

There are a number of definitions of carrying capacity, depending on the particular focus of each author's work. Rosier (1992, pp40-41) cites the following generally accepted definitions:

- **Ecological or Environmental Carrying Capacity**
  ".... the optimum number of individuals of a species that can survive in that area over an extended period" (Enger et al, 1983).

  ".... the level of equilibrium between the availability of a certain element limiting a given type of exploitation of an ecosystem and the level of exploitation of that element" (Geerling and de Bie, 1986).

  "..... the level of use an area can undergo before irreversible ecological damage is sustained" (Patmore, 1983).

- **Tourism Carrying Capacity**
  ".... the physical, biological, social and psychological capacity of a park environment to support tourist activity without diminishing environmental quality or visitor satisfaction" (Lindsay, 1986).

- **Recreational Carrying Capacity**
  ".... maintaining the integrity of the resource base and providing a recreation experience of high quality to the use" (Sowman, 1987).

Wagar (1964), as cited in Kuss et al (1990) defined carrying capacity as the "level of recreational use an area can withstand while providing a sustained quality of recreation". A definition which reflects current thinking, and which is useful from the perspective of developing environmental indicators, suggests that carrying capacity is the "level of use beyond which selected impact parameters exceed acceptable levels specified by evaluative standards" (Shelby and Heberlein, 1986, as cited in Kuss et al, 1990). Both definitions implicitly assume that socially acceptable levels of impact would be exceeded before environmentally acceptable levels.

Most researchers agree that the determination of carrying capacity therefore requires two separate elements:

- A description of the relationships between specific conditions of use (eg: types of use, site factors, amount of use) and the impacts associated with these conditions.

- An evaluative dimension which incorporates value judgements about the acceptability of various impacts to managers and users.
This implies a recognition of two components (Kuss et al, 1990):

- A quality environment
- A quality recreational experience

However, rather than focusing on the intrinsic value of resources which make up a "quality environment", the majority of research has focused on the development of guidelines for implementation of the carrying capacity concept in relation to maintaining a "quality recreational experience" (see Table 2.1)

Table 2.1: Implementation of the carrying capacity concept - guidelines

<table>
<thead>
<tr>
<th>Approach</th>
<th>Examples of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECREATIONAL OPPORTUNITY SPECTRUM (ROS)</td>
<td>Clark &amp; Stankey (1979)</td>
</tr>
<tr>
<td></td>
<td>Stankey &amp; Wood (1982)</td>
</tr>
<tr>
<td></td>
<td>The basic assumption underlying ROS is that quality recreational experiences can best be assured by providing a diversity of recreation opportunities.</td>
</tr>
<tr>
<td></td>
<td>Stankey et al (1985)</td>
</tr>
<tr>
<td>ULTIMATE ENVIRONMENTAL THRESHOLD METHOD (UET)</td>
<td>Kozlowski, Hill &amp; Rosier (1986)</td>
</tr>
<tr>
<td></td>
<td>UET is a land use planning techniques that may be used as an integral part of the planning process to identify and screen harmful environmental effects of development proposals.</td>
</tr>
<tr>
<td></td>
<td>A UET is the stress limit beyond which a given ecosystem becomes incapable of returning to its original condition and balance. UET method is applicable to natural areas and attractions.</td>
</tr>
<tr>
<td></td>
<td>UET Method involves the definition of:</td>
</tr>
<tr>
<td></td>
<td>Territorial UETs - areas from which activities must be excluded.</td>
</tr>
<tr>
<td></td>
<td>Quantitative UETs - the level up to which an activity can be developed.</td>
</tr>
<tr>
<td></td>
<td>Qualitative UETs - an indication of uniqueness, transformation and resistance of a resource.</td>
</tr>
<tr>
<td>VISITOR IMPACT MANAGEMENT (VIM)</td>
<td>Graefe, Kuss &amp; Vaske (1990)</td>
</tr>
<tr>
<td></td>
<td>An eight step sequential process for assessing and managing visitor impacts aimed at:</td>
</tr>
<tr>
<td></td>
<td>- Identification of problem conditions (unacceptable visitor impacts)</td>
</tr>
<tr>
<td></td>
<td>- The determination of potential causal factors affecting the occurrence and severity of the unacceptable impacts.</td>
</tr>
<tr>
<td></td>
<td>- The selection of potential management strategies.</td>
</tr>
</tbody>
</table>
Rosier (1992) notes:

"... ecological carrying capacity has generally been ignored in favour of social means of delimiting the use of natural resources ..... The research required to generate the information needed to understand ecosystems and develop monitoring systems is given less priority than research into user needs and management of prescribed settings.

Although there is a body of literature on the relationships between specific conditions of use (e.g. types of use, site factors, amount of use) and the impacts associated with these conditions, (as reviewed in Kuss et al., 1990), to date little attention has been focused on integrating the findings across ecological and social research. As a result, with the exception of the work initiated by the World Tourism Organisation Environment Committee (WTO), it appears that very little research has been undertaken with a view to developing environmental indicators of visitor impacts in and on natural areas/attractions.

Recognising the growing concerns over the link between tourism and the environment, the World Tourism Organisation has embarked on a task to develop a set of internationally accepted indicators or measures which will aid in providing managers and planners of tourism development with the information they need to understand their links with and impacts on the environment within which they operate (Manning, 1992).

The WTO initiative is being carried forward by an international “Working Group on Environmental Indicators”, involving representatives from Mexico, the United States, Canada and more recently, the Netherlands (Working Group in Environmental Indicators, 1993 & 1994). Each of these countries is currently working on case studies which will identify local level indicators of relevance to “hot spots”, i.e., those areas where:

- There is a concentration of tourism activity;
- There is known problems/degradation related to tourism;
- There is rapid change related to tourism; and
- There is extreme sensitivity related to tourism.

2.3 NZ - Monitoring/Surveying of Visitor Impacts Carried Out to Date

The Tourism Policy Group sent a letter to all Department of Conservation conservancies and several Regional and District Councils (Appendix B) on 15 April 1994 requesting preliminary information regarding any monitoring or one-off surveys carried out in regard to visitor impacts on natural areas or natural attractions (copy of letter in Appendix C).

The replies have been tabulated in Tables 2.2 and 2.3.
Table 2.2: Summary of replies from Department of Conservation conservancies on monitoring/surveying of visitor impacts

<table>
<thead>
<tr>
<th>Conservancy</th>
<th>Area/natural attraction surveyed/monitored</th>
<th>Parameters used</th>
<th>Agencies/groups involved</th>
<th>Continued involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland</td>
<td>Visitor numbers</td>
<td>DoC</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Auckland</td>
<td>Visitor numbers</td>
<td>DoC</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
| Waikato           | Whanganui-A-Hei Marine Reserve: visitor numbers to Hahei/ Cathedral Cove to measure impact of establishing reserve | • Track and road counters
• Aerial survey
• Visitor & community perceptions, activities |
Cathedral Cove Mngt Committee (community, iwi, scientists, DoC) | Yes |
| Waitomo Cave: impacts of visitors | • Water quality, CO₂, humidity
• Visitor numbers (automatic monitoring system) | Waitomo Caves Mngt Committee (DoC, iwi), THC |                       |                       |
| Opartere-Wharekawa Wildlife Refuge: visitor impacts on NZ Dotterals | • Visitor Nos, activities
• Dotteral behaviour & condition | DoC |                       |                       |
| Bay of Plenty     | No reply as yet                           | DoC                                                                             |                       |                       |
| Wanganui          | Regular visitor monitoring                | Visitor numbers                                                                 | DoC                                                                     |                       |
| Egmont National Park northern summit route impact assessment | • Track transects
• Photopoints
• Staff observation
• Visitor questionnaire | Lincoln University student |                       |                       |
| Egmont National Park Manganui skifield vegetation survey | Species composition in mown & unmown areas | Massey University |                       |                       |
| Egmont National Park visitor survey | Visitor satisfaction, perceptions, attitudes to management | Massey University |                       |                       |
| Whanganui National Park/Whanganui River visitor surveys: general survey 1992/3, Great Walk 1993/4 | • Use patterns
• Demographics
• Perceptions of impacts (crowding, environmental damage)
• Satisfaction with facilities | DoC Science & Research |                       |                       |
| Tongariro/ Taupo  | Haylen Waikato User Survey 1988           | • Visitor numbers
• User profiles
• Type of Envt sought
• Activities
• User perceptions
• Attitudes to DoC | DoC & Haylen Research | Yes |
<table>
<thead>
<tr>
<th>Conservancy</th>
<th>Area/natural attraction surveyed/monitored</th>
<th>Parameters used</th>
<th>Agencies/groups involved</th>
<th>Continued involvement</th>
</tr>
</thead>
</table>
| Tongariro/Taupo     | Tongariro River Recreation Survey 1992    | • Visitor numbers  
• User profiles  
• Sites visited  
• Activities  
• Natural and recreational values of river & environs  
• Effects of water flow & controls  
• Desired flow regimes  
• Perceptions of issues:  
  - Overcrowding  
  - Facilities  
  - Env'tl quality | DoC on behalf of all parties associated with Electricorp TPD, including MWRC & recreational user groups |                      |
| Hawke’s Bay         | No reply as yet                          |                                                                              |                                                                                           |                      |
| East Coast          | No reply as yet                          |                                                                              |                                                                                           |                      |
| Wellington          | Natural area monitoring                   | Visitor numbers                                                              | DoC                                                                                        | Yes                   |
|                     | One-off surveys of specific events in natural areas | Visitor numbers  
• Visual assessment of vegetation impacts on tracks through alpine areas  
• Visual assessment of pugging & new trampling  
• Photo points over time |                                                                              |                      |
| Kapiti Island       | Visitor numbers & impacts                 |                                                                              |                                                                                           |                      |
| Nelson/Marlborough  | Able Tasman Coast Track                   | Visitor Impacts & Perceptions, eg:  
• Overcrowding  
• Rubbish  
• Fishing pressure  
• Campsite impacts | DoC                                                                                        | Yes                   |
|                     | Heaphy Track                              | Visitor Impacts & Perceptions, eg:  
• Overcrowding  
• Rubbish  
• Mountainbike impact  
• Facilities | DoC                                                                                        |                      |
Table 2.2: Summary of replies from Department of Conservation conservancies on monitoring/surveying of visitor impacts (cont’d)

<table>
<thead>
<tr>
<th>Conservancy</th>
<th>Area/natural attraction surveyed/monitored</th>
<th>Parameters used</th>
<th>Agencies/groups involved</th>
<th>Continued involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nelson/</td>
<td>Queen Charlotte Walkway</td>
<td>Visitor Impacts &amp; Perceptions, eg:</td>
<td>DoC, Marlborough District Council</td>
<td></td>
</tr>
<tr>
<td>Marlborough</td>
<td></td>
<td>• Overcrowding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mountainbike impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canterbury</td>
<td>Minga Valley Coast to Coast - pre &amp; post event monitoring</td>
<td>Track condition using photo points</td>
<td>DoC on behalf of event organisers (Judkins)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One-off EIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One-off SIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mount Cook National Park Social Impacts of Aircraft</td>
<td>Visitor perceptions of noise</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td>West Coast</td>
<td>White Heron Colony</td>
<td>• Bird numbers</td>
<td>DoC, local iwi</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Visitor numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Monitoring</td>
<td>Numbers of visitors to:</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Huts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tracks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Field Trips</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air Craft Landings - Glaciers</td>
<td>No of aircraft landings</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td>Otago</td>
<td>Routeburn Track one-off survey 1990/1</td>
<td>Visitor numbers, crowding in huts</td>
<td>Student thesis</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Greenstone Track compaction monitoring 1993/4</td>
<td>Core samples from track, soil analysis</td>
<td>Student thesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rees-Dart Track visitor survey 1992/3</td>
<td>Satisfaction with facilities, track conditions</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gillespie Pass circuit visitor survey 1991/2</td>
<td>Satisfaction with facilities, track conditions</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dunedin area mountain bikes survey</td>
<td>Conflict between bikes, walkers &amp; other users</td>
<td>Student thesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Royal albatross colony, Taiaroa Head</td>
<td>Visitor &amp; facility impacts on birds, visitor Nos, siting of nests, bird breeding &amp; behaviour</td>
<td>DoC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visitor expectations of DoC</td>
<td>Design of survey system geared to facilities &amp; short walks</td>
<td>Student thesis</td>
<td></td>
</tr>
<tr>
<td>Southland</td>
<td>No reply as yet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2.3: Summary of replies from Regional and District Councils on monitoring/surveying of visitor impacts

<table>
<thead>
<tr>
<th>Local authority</th>
<th>Area/natural attraction surveyed/monitored</th>
<th>Parameters used</th>
<th>Agencies/groups involved</th>
<th>Continued involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland Regional Council</td>
<td>No reply as yet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auckland City Council</td>
<td>Airport visitor number, info bureaux &amp; number to Gulf Island</td>
<td>Tourism Auckland</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Rodney District Council</td>
<td>No reply as yet</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Rotorua District Council</td>
<td>Visitors to District Visitor numbers</td>
<td>RDC</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Taupo District Council</td>
<td>Lake Taupo and Waikato River</td>
<td>Water quality</td>
<td>Waikato Regional Council, DoC</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Visitors to District Visitor numbers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Huka Falls</td>
<td>Visitor numbers</td>
<td>NZ Tourism Board, DoC</td>
<td></td>
</tr>
<tr>
<td>Bay of Plenty Regional Council</td>
<td>No monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palmerston North City Council</td>
<td>No reply as yet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wellington Regional Council</td>
<td>Routine Monitoring of Regional Parks &amp; Principle Recreation Areas</td>
<td>• Visitor numbers&lt;br&gt; • Visual assessment of visitor impacts</td>
<td>WRC</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>One-off survey of Kaitoke Regional Park 1985</td>
<td>• Visitor profiles&lt;br&gt; • Visitor requirements&lt;br&gt; • Visual assessment of visitor impacts, eg: trampling of forest understory&lt;br&gt; • Overcrowding of carparks &amp; picnic areas&lt;br&gt; • Trackwear</td>
<td>WRC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pencarrow Coast Road Entrance to East Harbour Regional Park, 1991</td>
<td>Visitor numbers</td>
<td>RFBPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional surveys of outdoor recreation &amp; use, 1988 &amp; 1993</td>
<td>Visitor preferences: setting &amp; facilities</td>
<td>WRC</td>
<td></td>
</tr>
<tr>
<td>Marlborough District Council</td>
<td>No studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nelson City Council</td>
<td>Recreation, Conservation, Landscape Study, May 1994</td>
<td>Visitor needs, attractions</td>
<td>NCC</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 2.3: Summary of replies from Regional and District Councils on monitoring/surveying of visitor impacts (cont’d)

<table>
<thead>
<tr>
<th>Local authority</th>
<th>Area/natural attraction surveyed/monitored</th>
<th>Parameters used</th>
<th>Agencies/groups involved</th>
<th>Continued involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasman District Council</td>
<td>Maitai River, Waimea catchment, Motueka &amp; Riwaka Rivers and tributaries</td>
<td>Visitor numbers, activities</td>
<td>Nelson Catchment Board (NCB), NCB &amp; Fish &amp; Game Council</td>
<td></td>
</tr>
<tr>
<td>Christchurch City Council</td>
<td>Port Hills Survey 1993/94, Mt Cavendish Vegetation Survey</td>
<td>Tussock densities</td>
<td>CCC, DoC</td>
<td>Yes</td>
</tr>
<tr>
<td>Canterbury Regional Council</td>
<td>No studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queenstown Lakes District Council</td>
<td>Monthly Visitor Monitoring - Queenstown &amp; Wanaka</td>
<td>Visitor numbers, Accommodation, Repeat visit intentions, Recce to friends, Value for $, Means of transport</td>
<td>QLDC</td>
<td>Yes</td>
</tr>
<tr>
<td>Southland District Council</td>
<td>Milford area monitoring, Big River, Stewart Island</td>
<td>Biological, Effects of taxi boat wash on river banks, Visitor information</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
3 NATURAL ATTRACTIONS

3.1 Background

"New Zealand's major attraction has always been its spectacular natural scenic beauty ... The essence of the resource is New Zealand's distinctiveness and its relatively unspoiled environment" (New Zealand Tourism: Issues and Policies, 1984, as cited in Collier, 1989). New Zealand's natural assets include:

- Large undeveloped areas and national parks;
- Mountains;
- Lakes and rivers;
- Thermal activity;
- Scenic beauty and diversity within a relatively small geographical area;
- Large areas of coastline; and
- Distinctive animal, insect and plant life.

While any geographical area of a country or a region can be affected by tourism or recreation development, the most environmentally sensitive areas within New Zealand have been identified by Lands & Survey Department (1978, as cited in Collier, 1989) as:

- Coastal & Offshore Islands;
- Lakes and rivers (including lake shores and river banks); and
- High country & mountain areas.

New Zealand's cave networks, such as Waitomo, should also be identified as environmentally sensitive (Sowman, 1994, pers comm).

Wall and Wright (1977) note that particularly vulnerable areas will be those which support ecosystems with a low range of tolerance. For example:

- Areas with fragile vegetation;
- Areas with unstable slopes; and
- Wildlife breeding areas.

An examination of the recent report by the New Zealand Tourism Board and the Department of Conservation (1993), entitled "New Zealand Conservation Estate and International Visitors", indicates that these environmentally sensitive areas with fragile ecosystems are the areas which host New Zealand's major natural attractions (Figure 3.1).

These major natural attractions are listed at Appendix D and include well known areas of tourist concentration, such as Whakarewarewa Thermal Area, Waitomo Caves and Milford Sound. Also included are wildlife areas such as the Taiaroa Head Albatross Colony, as well as tramping tracks such as the Abel Tasman and Routeburn Tracks. Of the major attractions outside of land administered by the Department of Conservation, both the Shotover and Kawerau jetboating rate highly.
Figure 3.1: Major attractions and tramping tracks on the conservation estate
(NZ Tourism Board & Department of Conservation, 1993)
This information on natural attractions is supported by the "New Zealand International Visitors Survey 1992/93", published by the New Zealand Tourism Board in December 1993. The Survey found that short bush walks and scenic boat cruises were the most popular activities undertaken, with jetboating and scenic flights being the next most popular. Other popular activities of relevance to this Paper include rafting, other water sports, climbing/caving/mountain biking, long bush walks, bungy jumping, snow skiing, sea fishing, whale watching, freshwater fishing and tramping (Figure 3.2).

![Activities undertaken by visitors (NZ Tourism Board, 1993)](image)

**Figure 3.2: Activities undertaken by visitors (NZ Tourism Board, 1993)**

### 3.2 Categories of Natural Attractions in New Zealand

From information presented in the New Zealand literature it is possible to identify a number of categories of natural attractions in New Zealand based on:

- The type of attraction;
- The type of experience sought by visitors;
- The scale of activity;
- The degree of management.

These categories are identified in Table 3.1.

The purpose of identifying categories of natural attraction is to assist in the identification of the types and scale of visitor impacts and subsequently the development and selection of appropriate environmental indicators.
### Table 3.1: Categories of natural attractions in New Zealand

<table>
<thead>
<tr>
<th>Category</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major natural attractions for international visitors</td>
<td>• Short bush walks&lt;br&gt;• Short walking tours of attraction&lt;br&gt;• Scenic Boat Cruises&lt;br&gt;• Jet Boating&lt;br&gt;• Scenic Flights</td>
</tr>
<tr>
<td>Natural attractions based on flora, fauna and landscape features</td>
<td>• Viewing - on-foot, by vehicle, boat or air, from viewing platform&lt;br&gt;• Short walks&lt;br&gt;• Tramping&lt;br&gt;• Mountaineering&lt;br&gt;• Rockclimbing&lt;br&gt;• Camping</td>
</tr>
<tr>
<td>Natural Areas/Attractions for adventure tourism and/or recreation (within and outside land administered by the Department of Conservation)</td>
<td>• Ski fields&lt;br&gt;• Fishing&lt;br&gt;• Jet boating&lt;br&gt;• Bungy jumping&lt;br&gt;• Endurance events&lt;br&gt;• Mountainbiking</td>
</tr>
</tbody>
</table>
Kuss et al (1990) conclude that studies of recreation impacts highlight five principles:

i. There is no single predictable response to recreational use. Instead an inter-related set of impact parameters can be identified.

ii. Impact parameters are related to varying levels of use intensity although most impacts do not exhibit a direct linear relationship with user density. Use/impact relationships are influenced by many aspects of use intensity and a variety of situational factors.

iii. One of the most important factors affecting use/impact relationships is the inherent variation in tolerance among environments and user groups.

iv. Activity-specific influences represent a second major set of considerations affecting use/impact relationships. Some types of activity create impacts faster or to a greater degree than other types of activity. Impacts can vary even within a given activity according to type of transportation or equipment used and visitor characteristics such as party size and behaviour.

v. The impacts of activities are influenced by a variety of site specific and seasonal variables.

From the literature it is possible to identify a number of potential generic environmental impacts (see Table 4.1). For each of these generic impacts, it will be necessary to identify a number of more specific impacts, together with associated standards. At the site specific level, appropriate variables for monitoring will need to be selected and surveyed/sampled. It is from these parameters that indicators will have to be developed and monitored.

**Table 4.1: Generic environmental impacts**

<table>
<thead>
<tr>
<th>Potential environmental impacts - generic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Damage to natural feature</td>
</tr>
<tr>
<td>• Habitat degradation</td>
</tr>
<tr>
<td>• Changes in animal behaviour</td>
</tr>
<tr>
<td>• Reduced biodiversity</td>
</tr>
<tr>
<td>• Soil erosion &amp; compaction</td>
</tr>
<tr>
<td>• Pollution - sewage disposal, discharges to air, solid waste disposal &amp; litter</td>
</tr>
<tr>
<td>• Noise from aircraft, boat and vehicle traffic/parking</td>
</tr>
<tr>
<td>• Aesthetic - structures &amp; crowding</td>
</tr>
</tbody>
</table>

Buckley and Pannell (1990) identify three main categories of specific visitor impacts on the natural environment:

- Those associated with accommodation and shelter;
- Those associated with recreational activities per se; and
- Those associated with transport.
Potential impacts on the physical and biological environment in each of these categories are summarised in Appendix E, Tables 1 to 3.

However, as noted by Kuss et al. (1990), actual impacts will be site-specific and will need to be investigated and monitored at a site specific level.

Environmental impacts affect the number and type of visitors to natural attractions. Surveys of visitors to natural areas show that they expect and want such areas to have little or no development. Visual impacts, noise and crowding are common sources of complaint, as is environmental damage. Many of these complaints reflect conflicts between different groups of visitors, notably between those who use mechanised means of transport and those who do not. However, these concerns are often disguised by recreational succession, or opportunity shift, as the number and density of visitors at a particular site increases, and the characteristics of that area change in consequence. The type of people visiting the area, and their expectations, enjoyment and requirements, change over time.

However, even if explicitly identified, opportunity shift makes it extremely difficult to monitor deterioration in the quality of visitor experience in any given area (Buckley and Pannell, 1990).
5 MANAGEMENT FRAMEWORK

5.1 Background

One of the major determinants of visitor impacts on natural areas and natural attractions will be the degree and type of statutory protection and/or the current management regime.

5.2 Conservation Act 1987

The majority of New Zealand's natural attractions (as identified in Appendix D) fall under land administered by the Department of Conservation and are therefore under the legislative framework of the Conservation Act 1987.

The Conservation Act 1987 (the Act) outlines:

i. The functions of the Department of Conservation (DoC).

ii. The planning and management duties of DoC under all enactments brought under the scope of the Act. These enactments are listed in the First Schedule to the Act and include:

- Reserves Act 1977
- Marine Reserves Act 1971
- Wildlife Act 1953
- Marine Mammals Protection Act 1978
- Wild Animal Control Act 1977
- New Zealand Walkways Act 1980
- National Parks Act 1980

DoC may develop general policies, conservation management strategies and conservation management plans in relation to land administered by DoC. General policies are intended to address policy issues of general application throughout New Zealand. For example, there are existing general policies for national parks. Conservation management strategies are designed to implement general policies and establish objectives for the management of natural and historic resources. A conservation management strategy is currently being prepared by all conservancies.

Conservation management plans implement conservation management strategies and establish detailed objectives for the management of conservation assets. National parks are an exception as they have management plans of their own under the National Parks Act.

The Conservation Act, together with the enactments listed in the First Schedule to the Act, provide for differing levels of statutory protection and different management objectives, depending on the Act under which an area has been protected, and the purpose for which it has been protected (see Figure 5.1 for an example of how the Conservation Act provides for the conservation of natural and historic resources).
5.3 Resource Management Act 1991

There are a number of other natural attractions, including natural features and adventure tourism opportunities which occur outside of the conservation estate. These activities must therefore be managed in accordance with the Resource Management Act, 1991 (RMA), and any relevant national and regional policy statements, and regional and district plans.

Management of areas outside of land administered by the Department of Conservation will be focused on the effects of any activities and is likely to be based on the restrictions outlined in Part III of the RMA which relate to land use, the taking of water, the discharge of contaminants to air, land or water, and activities in the coastal marine area.

The RMA also explicitly provides for heritage protection, water conservation orders, esplanade reserves, esplanade strips and public access strips.

5.4 Local Government Act 1974

Section 601 of the Local Government Act 1974 (LGA) relates to recreation and community development. Under this Section, local authorities have the power to provide services, facilities, amenities and programmes for recreation, amusement and instruction, and for improvement, development or maintenance of amenities for the public, including walkways under the New Zealand Walkways Act 1975. The LGA also provides for Auckland and Wellington Regional Councils to have Regional Parks.
5.5 Implications for the Development of Environmental Indicators

Management objectives for each type of "reserve" will depend to a large extent on the Act under which it was taken and purpose of management under that Act. This will affect the type of activities allowed to take place in a natural area, and the subsequent type and extent of environmental impacts. The implication is that the environmental indicators will have to be developed and selected which provide for or reflect these different management circumstances and management objectives.
6 DEVELOPMENT OF ENVIRONMENTAL INDICATORS

6.1 Monitoring and the Use of Indicators

Hellawell (in Goldsmith, 1991) notes that although the term “monitoring” is still often used in a very broad sense, more recently a set of stricter definitions are being used as follows:

- **Survey**
  An exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardised procedure and within a restricted period of time, but without any preconception of what the findings ought to be.

- **Surveillance**
  An extended programme of surveys, undertaken in order to provide a time series, to ascertain the variability and/or range of states or values which might be encountered over time (but again without preconceptions of what these might be).

- **Monitoring**
  Intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from an expected norm.

The reasons for instituting a monitoring programme may be classified into three general categories. These are:

i. Assessing the effectiveness of policy or legislation
ii. Regulatory (performance or audit function)
iii. Detecting incipient change (early warning).

Podani (in Kovacs, 1992) states that “monitoring is a system of regular observations, both temporal and spatial, that provides information on the state of the environment. It aims to make comparisons between past and present states. Data collected by monitoring are expected to be useful in predicting future changes.”

With the main emphasis being placed on environmental changes and their measurement, data can only be informative and suitable for assessment if observations can be related to some standard of comparison.

The selection of key indicators from which a “signal” is to be generated depends upon the objectives of the monitoring exercise. Indicators provide information about the state of the environment without having to peruse all the environmental variables that have been or could be measured. They may be predictive, descriptive, show trends over time and must be capable of illustrating the relationship between the cause or stressor (eg: visitors into natural areas) and the environmental effect or outcome (eg: specific visitor impacts). According to Ward (1990), indicators should:

i. be capable of identifying changes in environmental conditions (quantity and quality) and the cause (agents) of these changes;

ii. be understandable to the general public and decision makers as well as scientists;

iii. be limited in number if they are to be useful to decision makers;

iv. be scientifically defensible;
v. be sensitive to change in space and time;

vi. be based on relative ease of data collection, and where possible and appropriate, be based on existing data collection, storage, retrieval and interpretation programmes; and

vii. provide early warning of adverse environmental effects.

"Above all, indicators need to be useful tools; the reason for their existence is that they aid understanding, and help managers to avoid risks ..... with more complete knowledge of likely outcomes." (Manning, 1992, p5)

6.2 The Development of Indicators

Environmental indicators are a measure of the effect that human activities have on natural resources, ecosystem and their component parts (Ward & Beanland, 1992).

The United States Environmental Protection Agency (Hunsaker & Carpenter, 1990) state that for all classes of ecological resources, the following questions need to be answered:

- What is the current extent (geographical area, wildlife population, vegetation cover) of the resource?
- What is the extent of degradation - versus good/acceptable condition?
- What proportions are degrading or improving in which parts?
- Are these changes correlated with patterns and trends in environmental stresses?
- Are degraded areas improving overall in response to management responses?

Manning (1992) states that the initial concept of the indicators of sustainable tourism is that they will encompass:

- Environmental factors and sensitivities;
- Measures of human actions which stress the environment;
- Measures of results of human impact; and
- Measures of the human and biological consequences of these impacts.

However, in order to identify the indicators that need to be monitored the information required includes:

- The type of ecosystem on which a natural attraction is based;
- The category of attraction (scale and type of use/activities carried out);
- The potential environmental impacts associated with the type of ecosystem and the use to which it is subjected; and
- Management information - ie, the objectives and status of management in relation to the attraction.

The type of indicators chosen depends on the objectives of management and their relative priorities. For example, if the objective is to preserve natural environments, key indicators may be:

- Those which measure areas protected; and
- Losses of critical attributes which are the focus of protection (species, ecosystems).
If the objective is to reduce risk of degrading environments used by humans (beaches, built attractions), the most important indicators may be:

- Levels of use;
- Extent of impact on the biological or cultural values critical to continued use; and
- Market trends showing changes in interest in continuing to frequent the area (Manning, 1992).

These issues are highlighted in the remainder of this Section, and illustrated in the Case Studies that follow in Section 7.

### 6.3 Information Requirements to Identify Indicators

In order to identify the indicators that need to be monitored, there are a number of questions that need to be answered to define the type of indicator required.

1. The type of ecosystem needs to be identified - whether it is aquatic (river, lake, wetland etc) or terrestrial (forest, shrubland, grassland etc), the altitude (alpine, subalpine, coastal etc) or an offshore island. The sensitivity or resilience of the ecosystem needs to be noted.

2. The category of attraction and use of the site to visitors.

3. The potential environmental impact of the site in relation to the type of ecosystem and the use to which it is subjected.

4. The management information that needs to be known to identify the objectives of management and hence the expectations of visitors in terms of facilities, crowding, natural features or wilderness experience.

Indicators of potential environmental impacts of an activity at a site can be developed from the generic list shown in Table 4.1. Also, criteria that have been used for ecological carrying capacity (see Rosier, 1992) are also useful for developing indicators. The type of variables to be assessed and from which specific indicators can be selected or developed are shown in Table 6.1.
Table 6.1: Development of indicators from potential environmental impacts

<table>
<thead>
<tr>
<th>Potential environmental impacts</th>
<th>Variables to be assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>vegetation degradation</td>
<td>Area degraded, change in species composition and community structure, % cover of introducted weeds, cumulative use of site, soil type, slope, climate</td>
</tr>
<tr>
<td>soil erosion and compaction</td>
<td>Area affected, % bare ground, slope, aspect, soil type, climate</td>
</tr>
<tr>
<td>wildlife behaviour (varies within and between species)</td>
<td>Loss of habitat, food supply, change in feeding patterns, breeding success, effect on productivity resulting in disturbance of essential functions, severe exertion, displacement, death</td>
</tr>
<tr>
<td>reduced biodiversity</td>
<td>Sp numbers</td>
</tr>
<tr>
<td>impacts on selected species or groups of species</td>
<td>Population levels, general health, resilience to impact (function of size of impact and significance to species)</td>
</tr>
<tr>
<td>indirect effects on other species (eg: birds, rodents, reptiles, insects)</td>
<td>Changes in species behaviour, productivity etc</td>
</tr>
<tr>
<td>negative effects of crowding, structures</td>
<td>Complaints, reduced visitor Nos.</td>
</tr>
<tr>
<td>pollution - water, sewage and waste disposal, litter</td>
<td>Level of use, faecal coliforms, giardia, erosion and sedimentation, flow and dilution rates, nutrient enrichment, amt. sewage discharged, waste produced, litter collected</td>
</tr>
<tr>
<td>noise from air, road or boat traffic</td>
<td>Complaints, reduced visitor numbers</td>
</tr>
<tr>
<td>damage to natural features</td>
<td>Type of damage, area affected</td>
</tr>
</tbody>
</table>

Degraded tracks have been found to adversely affect visitor enjoyment (McQueen, 1991). The study by McQueen concluded that the levels of use and site characteristics such as climate, soil, vegetation and topography control level of impact. At lower levels of use the main impact is on vegetation, while at higher levels of use the most impact is on soils. There is a need to distinguish between rate of use and cumulative use in contributing to track degradation. There exists a lower threshold below which impacts are recoverable and above which impacts are not readily absorbed by the site and where impact is related to total use. At an upper threshold, most degradation has taken place and little more will occur. Cumulative use between these two thresholds may be a key indicator to measure. Track sites with deep soft soils, unstable slopes and poor drainage are particularly sensitive to degradation. Bayfield (1973) found that the width of the trampled vegetation increased with increasing path wetness and with increasing angle of slope for paths crossing hillsides.

McQueen estimates that, depending on the environment, 500-1000 users of a track in a year will result in track deterioration unless the track is hardened. 2000-3000 users per year will result in almost total soil removal on slopes unless the track is protected.

Impacts of trampling on vascular plants have been discussed by Kuss et al (1990). These include the effects of soil compaction which reduces root penetration and affects nutrient uptake, seed establishment and germination. Loss of vegetation cover changes the microclimate which many seedlings need for survival by reducing humidity and creating more extreme temperature ranges.

Physiological impacts of trampling interfere with normal plant physiological activities by disrupting photosynthesis and energy utilisation, especially during the growing season which is also the high use period. As the habitat of affected areas becomes altered, the recolonising species will be different, often from a restricted range of genera, and resistant to trampling. Wall and Wright (1977) summarise the ecological effects of trampling in Figure 6.1.
Impacts on wildlife are probably the most difficult impacts to measure. They are complex and very little research has been carried out on the relationship between the number of visitors to a natural site and wildlife behaviour and population variables (Kuss et al, 1990). Direct and indirect impacts of outdoor recreation are illustrated in Figure 6.2. Impacts have been summarised by Kuss et al as:

**Impact interrelationships:** Direct "harassment" by people and indirect impacts on habitat, food sources etc.

**Use-impact relationships:** No uniform relationship between degree of recreational use and wildlife impact indicators. Particular types of recreational use, frequency of use and visitor behaviour appear to be more important than number of visitors using a given area.

**Varying tolerance to impacts:** Types of wildlife vary in their tolerance to interactions with humans. Some species benefit while others decline. Individual responses within a species vary in response to human impacts.

**Activity-specific influences:** Some types of recreation have greater impacts than others and varies with the experience of the species to the type of recreation and the behaviour of the visitors.

**Site-specific influences:** Impacts of recreation on wildlife are affected by the specific site and seasonal conditions.
Water quality problems associated with recreation include viral, parasite and bacterial contamination and associated health risks, nutrient enrichment of receiving waters, turbidity and sedimentation, and changes due to accelerated eutrophication (Kuss et al., 1990). Most problems are associated with the level of use of the site or area.

6.4 Management Information

The development of indicators is related to the management of the activity at a particular site. Indicators are required to assist decision makers to decide "... how much preservation is necessary, how much conservation is possible, and how much depletion is tolerable" (Swaine, 1992).

Table 6.2 lists the type of information requirements.

Inter-relationships between recreational impacts are shown in Figure 6.3.

Management information listed in Table 6.2 sets the scene for the development of indicators of environmental impact by clarifying the expected state of a site in terms of its statutory protection and existing management, its past and current use, its vulnerability to impacts, and changes that may have occurred between the time of a baseline survey and the results of ongoing monitoring.
### Table 6.2: Management information required to develop indicators

<table>
<thead>
<tr>
<th>Information category</th>
<th>Management information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership/designation of land</td>
<td>Eg: Conservation Estate/Crown Land/privately owned</td>
</tr>
<tr>
<td>Statutory Protection</td>
<td>Type &amp; purpose of protection and subsequent management objectives. Adequacy of current protection</td>
</tr>
<tr>
<td>Baseline Survey</td>
<td>Existing data, eg: Protected Natural Area survey with Recommended Areas for Protection, reports on natural feature/attraction - pre “development”</td>
</tr>
<tr>
<td>Type and level of use</td>
<td>Visitor numbers and activities</td>
</tr>
<tr>
<td>Environmental Impact Assessment</td>
<td>EIA as part of “development” proposal</td>
</tr>
<tr>
<td>Management Plans</td>
<td>Existence, relevance, implementation of plan</td>
</tr>
<tr>
<td>Assessment of Actual Impacts - One off surveys</td>
<td>Existing data, reports on environmental impacts of visitors on natural feature/attraction</td>
</tr>
<tr>
<td>Monitoring</td>
<td>On-going monitoring of “state” of the environment, impacts of “development”/visitors, effectiveness of any management plans</td>
</tr>
</tbody>
</table>

![Figure 6.3: Recreational impact inter-relationships (Wall & Wright, 1977)](image)

The level of environmental impact that is acceptable under the management situation at a particular site will dictate which environmental variables, such as those listed in Table 6.1, need to be assessed. Some of these variables will be suitable as indicators; other will need further development.
The need for monitoring particular sites is not only to record change and the effectiveness of management but also to act as early warning of irreversible changes to sensitive ecosystems that may not be anticipated. The choice of the correct indicators is vital to alerting management to critical conditions.

For any particular type of ecosystem and a given type of attraction, the existence and type of statutory protection and management objectives will dictate the type of indicators that need to be developed.

The suitability of the above framework is tested in the following case studies.
The following case studies were selected on the basis of:

- **Ecosystem type** with indications of those particularly vulnerable to impacts as suggested in Section 3.1.

- **Attraction category** for visitors to the site as shown in Table 3.1.

- **Impact status** with potential impacts to the particular ecosystem.

- **Availability of information** which proved to be the deciding factor in the selection because many potential case study sites appeared to have no up to date or readily available information.

Using the above categories and type of management information listed in Table 6.2, each area selected as a case study was assessed according to the information available.

**Case Study 1: Kapiti Island Nature Reserve**

<table>
<thead>
<tr>
<th>Information required</th>
<th>Site-specific information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem type</td>
<td>Offshore island, regenerating native forest, rich native birdlife</td>
</tr>
<tr>
<td>Attraction category</td>
<td>Flora, fauna and landscape features</td>
</tr>
<tr>
<td>Primary activity</td>
<td>Walking, bird watching, island experience</td>
</tr>
<tr>
<td>Level of use</td>
<td>Visitor numbers</td>
</tr>
<tr>
<td>Potential impacts</td>
<td>Vegetation degradation, habitat disturbance, fire, invasion by plant and animal pests, pollution, crowding</td>
</tr>
<tr>
<td>Land ownership/</td>
<td>Crown land/Nature Reserve (entry by permit), partly surrounded by a Marine Reserve</td>
</tr>
<tr>
<td>Statutory protection</td>
<td>Bird survey</td>
</tr>
<tr>
<td>Baseline survey</td>
<td>Management Plan, track development, basic facilities, SIA, visitor numbers limited to 250/wk and 50/day from Sept 1993</td>
</tr>
<tr>
<td>Management</td>
<td>Crowding affecting experience (solitude, bird watching)</td>
</tr>
<tr>
<td>Existing monitoring programmes</td>
<td>Bird counts</td>
</tr>
</tbody>
</table>

This island is a Nature Reserve so the restricted entry status enables visitor management to be more clearly defined. It appears that there is no baseline vegetation survey against which to monitor deterioration of habitat due to visitors. However recent track development has taken place and visitor numbers are limited. Social impact and bird information are available and some indicators could be developed on the basis of the current information.
Types of indicators that would need to be developed in relation to visitor numbers, especially after the introduction of recent limitations on numbers, include:

- Changes in vegetation degradation (Table 6.1)
- Changes in soil erosion and compaction (Table 6.1)
- Change in bird numbers and distribution
- Changes in visitor expectations
- Changes in perceptions of crowding
- Achievement of management objectives
- Need for new management objectives as a result of new information

### Case Study 2: Royal Albatross Colony, Taiaroa Head

<table>
<thead>
<tr>
<th>Information required</th>
<th>Site-specific information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem type</td>
<td>Coastal headland, internationally unique mainland bird breeding area</td>
</tr>
<tr>
<td>Attraction category</td>
<td>Flora, fauna and landscape features</td>
</tr>
<tr>
<td>Primary activity</td>
<td>Guided walks to view birds</td>
</tr>
<tr>
<td>Level of use</td>
<td>Visitor numbers</td>
</tr>
<tr>
<td>Potential impacts</td>
<td>Human presence, noise</td>
</tr>
<tr>
<td>Land ownership/Statutory protection</td>
<td>Nature Reserve with surrounding land in reserve status (lighthouse reserve, Pilots Beach Recreation Reserve)¹</td>
</tr>
<tr>
<td>Baseline survey</td>
<td>Colony monitored since 1937, daily since 1968¹</td>
</tr>
<tr>
<td>Management</td>
<td>Bird management (weighing, banding), predator control, habitat maintenance</td>
</tr>
<tr>
<td></td>
<td>Viewing structures, tracks¹</td>
</tr>
<tr>
<td>Site specific impacts</td>
<td>Movement of birds out of view of visitors, size of un-impacted nesting area available¹</td>
</tr>
<tr>
<td>Existing monitoring programmes</td>
<td>Impacts of visitors and facilities on birds, visitor numbers, siting of nests, bird breeding and behaviour</td>
</tr>
</tbody>
</table>

¹ Data from Robertson (1994)

This site is a Nature Reserve, surrounded by other reserves, so restricted access to visitors enables management of visitor numbers, despite the fact that this is a mainland site. Appropriate management is critical to the sustainability of this site as a mainland breeding area for these birds so they can be viewed by visitors. A delicate balance is needed between interference by humans to enhance chick survival and keep them in view for visitors and allowing the birds to breed free from stress. Because of the longevity of these birds, the effects of stress in early life may not be manifested for many years, so any early warning indicators of stress need to be heeded for the long term management of the colony. Comprehensive monitoring is being undertaken so key indicators could be developed.
Types of indicators that need to be developed in relation to visitor numbers to the site, design of facilities, and day to day management activities of the birds and their habitat could include:

- Habitat degradation (Table 6.1)
- Predator numbers
- Change in bird numbers, distribution and behaviour
- Changes in visitor expectations
- Achievement of management objectives
- Need for new management objectives as a result of new information

**Case Study 3: Speights Coast-to-Coast endurance event through Arthurs Pass National Park**

<table>
<thead>
<tr>
<th>Information required</th>
<th>Site-specific information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem type</td>
<td>National Park, Rata-kamahi forest (Deception Valley), subalpine shrubland, alpine vegetation (Goat Pass), beech forest (Mingha Valley)</td>
</tr>
<tr>
<td>Attraction category</td>
<td>Natural area for recreation</td>
</tr>
<tr>
<td>Primary activity</td>
<td>Running</td>
</tr>
<tr>
<td>Level of use</td>
<td>Visitor numbers</td>
</tr>
<tr>
<td>Potential impacts</td>
<td>Vegetation degradation, soil erosion and compaction, increased width of track, change in animal behaviour, reduced biodiversity, litter</td>
</tr>
<tr>
<td>Land ownership/Statutory protection</td>
<td>National Park, land administered by Department of Conservation</td>
</tr>
<tr>
<td>Baseline survey</td>
<td>Palmer, 1979</td>
</tr>
<tr>
<td>Site specific impacts</td>
<td>Vegetation degradation, erosion¹</td>
</tr>
<tr>
<td>Existing monitoring programme</td>
<td>Photo points of track condition, before and after the event.</td>
</tr>
</tbody>
</table>

¹ Impacts were worst where drainage was poor, track water-logged, and hence boggy sections developed (Norton 1989)

The National Park status of this attraction limits the potential impacts on the environment to some extent in terms of prohibited activities under the National Parks Act 1980 and the Management Plan but not the visitor numbers taking part in and supporting this event. Sufficient information is available on impacts of vegetation degradation for indicators to be developed for visitor impacts during this endurance event. However, long-term monitoring of cumulative damage to flora or fauna in the region is lacking and needs further information for the development of early warning indicators of irreversible change.
Types of indicators that would need to be developed in relation to visitor numbers, include:

- Changes in vegetation degradation (Table 6.1)
- Changes in soil erosion and compaction (Table 6.1)
- Change in bird numbers and distribution
- Changes in participant expectations
- Compliance with National Park management objectives
- Need for new management objectives as a result of new information

These three case studies illustrate the use of the information in Section 6 in developing indicators and highlight some of the complexity involved. The three studies all concern land with significant statutory protection in the form of restricted access to Nature Reserves or the protection status of National Parks. Consequently, there is a similarity in the type of indicators that need to be developed and, given the information available for these sites, it would seem possible to develop a suite of generic indicators for sites such as these.

Other case studies would provide the basis for the development of other suites of indicators for land with less statutory protection and involving different types and levels of visitor activities.

Indicators of visitor impacts for a specific natural attraction or site can be identified from the generic indicators for similar ecosystems, protection status and visitor activities.
i. Since the demand for natural-areas recreation and tourism is increasing, and the supply of natural areas is not, it is realistic to assume that levels of recreation and tourism associated with natural attractions will continue to increase in the immediate future.

ii. Informed management to minimise the impacts of such tourist pressure is therefore particularly important. This requires information on the relationship between visitor numbers and activities, and their impacts on particular types of environment.

iii. The results of the literature review and initial consultation with relevant agencies has highlighted that New Zealand is no different from other nations when it comes to monitoring visitor impacts. Research and monitoring has focused on visitor numbers and while the concept of carrying capacity can be found throughout the literature, the emphasis is on the implementation of this concept in relation to maintaining a “quality recreational experience” (ie, visitor satisfaction), as opposed to ecological carrying capacity. The assumption in a large proportion of the literature is that the threshold (or bottom line) of visitor satisfaction will be compromised before any significant ecological damage occurs. This assumption is disturbing for two reasons:

- The absence of any ongoing monitoring of visitor impacts on the natural environment.
- The concepts of opportunity shift, cyclical degradation and the “last settler syndrome”, whereby the types of visitors to an area change in response to environmental changes, and the visitors seeking a more “pristine” environment, move further into the “wilderness areas”.

iv. New Zealand has a variety of natural attractions. Not all of these attractions will be equally sensitive to visitor impacts. However, it is possible to identify potential generic and specific impacts depending on:

- Ecosystem type
- The type of natural attraction
- The type of experience sought by visitors
- The scale of activity
- The degree of management

It is therefore suggested that the first requirement is for baseline information on numbers, types and behaviours of visitors to different natural attractions in order to determine potential impacts. The second requirement is to monitor environmental change in order to identify actual impacts.

v. This implies the need for groups or “suites” of environmental indicators to be developed for different categories of natural attractions, reflecting:

- The type of ecosystem on which a natural attraction is based.
- The category of attraction (scale and type of current/potential use/activities).
- The potential environmental impacts associated with the type of ecosystem and the use to which it is subjected.
- Management information - ie, the objectives and status of management, including management responses (eg: track hardening, restrictions on numbers) in relation to the attraction.
vi. These requirements are illustrated in Tables 6.1 and 6.2 of this Paper. This type of framework for organising information can help to identify which types of site specific impacts should be monitored, and subsequently the type of environmental indicators to be developed, selected and monitored.

vii. The development of environmental indicators of visitors in natural areas is in its very early stages worldwide. The approach followed in this Paper has drawn on the work so far undertaken by the World Tourism Organisation's "Working Group on Environmental Indicators". However, like the literature, the work of the Group highlights the need to develop indicators at the site specific level, in relation to identified "hot spots".

viii. The case studies in Section 7 of the Paper have been selected to test the applicability of this approach. The results indicate that the approach is applicable for the following reasons:

- It is important to be certain of the need for monitoring prior to developing site specific indicators of visitor impacts.

- It is important that the right indicators are developed and selected. For example, indicators for wilderness areas may be different from those for scenic reserves or non-conservation land.

- Given a particular set of circumstances (ecosystem type, level of use, degree of management), expensive environment monitoring may not be necessary in all cases. Higher level, more generic indicators (eg, in relation to management status, visitor numbers) may be all that is required until certain identified "milestones" are reached (or not reached). It is important that indicators are related to management objectives, environmental standards or limits of acceptable impacts.

- In New Zealand there is likely to be a shortage of financial resources and expertise to implement monitoring of visitor impacts on the natural environment. Prioritised and targeted monitoring of "hot spots" will therefore be essential.

- The process of developing indicators of sustainable tourism must be flexible enough to allow for adaptation and improvement as the results of research and monitoring activities become available, and as new evidence of visitor impacts arises.

- This approach facilitates the identification and prioritisation of "hot spots".

xi. This Paper highlights a number of implications in relation to the development of environmental indicators of tourism in natural areas. As such, it provides the basis for further discussion on the feasibility, applicability and practicality of further developing and implementing these in the New Zealand context.

Such an evaluation could not be undertaken without consultation with a number of key agencies involved in both the management of the natural environment and/or tourism (eg, Department of Conservation, Ministry for the Environment, New Zealand Tourism Board, local authorities). Nor could it be carried out without the basis for discussion, now provided by this Paper.

However, such an evaluation is essential, and should take into account the current economic and political structure within which New Zealand tourism operates.
8.1 Where To From Here?

This Paper has suggested an approach to the development of environmental indicators for tourism in natural areas. It is a preliminary study only and, to some extent, has raised more questions than it has answered. It is therefore recommended that:

i. New Zealand keep abreast of work being undertaken by international initiatives and become involved where appropriate or possible.

ii. Tourism Policy Group supply a copy of this Paper to all agencies with whom initial contact has been made, together with those agencies listed in item (iv) below.

iii. The Ministry facilitate the further development of generic indicators using additional case studies of different ecosystems, types of natural area protection and levels of use.

iv. An evaluation of the feasibility and practicality of further developing and implementing environmental indicators should be initiated by the Tourism Policy Group and should involve those agencies who have indicated an ongoing interest in assisting the Ministry (Tables 2.2 and 2.3) and include representatives from:
   - New Zealand Tourism Board
   - Ministry for the Environment
   - Department of Statistics
   - Representatives of the New Zealand Tourism Industry
   - Representatives of relevant research institutions (universities, CRI’s)

The evaluation could take place in a workshop forum.

v. Questions to be addressed by the evaluation should include fundamental issues such as:
   - *At what level of use, for each ecosystem type, should monitoring of visitor impacts on natural areas be necessary?*
   - *Who should pay* for further research into, and implementation of, the concepts discussed in this Paper?
   - Where does the development and monitoring of indicators of tourism fit in relation to the work that has been carried out by DoC and MfE in the development of indicators and *State of the Environment Reporting?*
   - *What is the purpose* of this work? If the development and monitoring of key indicators goes ahead, what will the information be used for - ie, *how will the information be used* in the best interests of the relevant parties (including the New Zealand public and the tourists)?
   - *Are agencies in a position to be involved* in and/or develop and implement monitoring programmes in relation to visitor impacts on the natural environment?

vi. Indicators of social, cultural and economic impacts of tourism need further examination and need to be integrated with the development of environmental indicators.
vii. On the basis of this evaluation/consultation, and in conjunction with other central government agencies, the Tourism Policy Group should develop a national policy perspective on the development and monitoring of indicators of visitor impacts.
REFERENCES


APPENDIX A
PROJECT METHODOLOGY

Step 1 Literature search and review in relation to:
- Major New Zealand natural attractions and ecosystems of importance to tourism
- Data relating to tourism/visitors in natural areas
- Sustainable tourism
- Impacts of tourism/visitors on natural attractions
- Monitoring the impacts of tourism on natural attractions
- The development of environmental indicators with specific reference to visitor impacts on natural attractions

Step 2 Development of a contact list of relevant staff within Department of Conservation regional conservancies and local government who may have an interest in monitoring specific natural areas or major natural attractions (refer to Appendix B).

Step 3 Letter prepared for Ministry of Tourism to send to those agencies identified in Step 2 (refer to Appendix C for a copy of the letter).

The letter:
- Informed the contacts about the project
- Surveyed whether, and to what extent data has been or is being gathered in relation to visitor impacts on natural attractions.
- Requested a response as to whether or not the contact person, on behalf of the agency, would like to continue being involved in the project.

Step 4 Follow up of those agencies contacted.

Step 5 Collation and integration of information received.

Step 6 Identification of major attractions of importance to tourism in New Zealand.

Step 7 Identification of the actual and potential impacts of visitors on these attractions.

Step 8 Identification of monitoring/surveying of visitor impacts carried out to date.

Step 9 Identification of information gaps.

Step 10 Development of a set of variables to be assessed for different environmental impacts.

Step 11 Identification of management information required to assess environmental impacts.

Step 12 Use of framework in Case Studies.

Step 13 Preparation of report, including recommendations for further development and monitoring of environmental indicators for tourism in relation to natural attractions.
APPENDIX B
INITIAL CONTACT LIST

Local Authority Contact List:

Attention: Senior Planner, Recreation/Tourism Officer

Auckland Regional Council
Auckland City Council
Rodney District Council
Rotorua District Council
Taupo District Council
Bay of Plenty Regional Council
Palmerston North City Council
Wellington Regional Council
Marlborough District Council
Nelson District Council
Tasman District Council
Christchurch City Council
Canterbury Regional Council
Queenstown Lakes District Council
Southland District Council

NB: All DoC conservancies will be contacted
Development of Environmental Indicators for Tourism in Natural Areas: A Preliminary Study
Dear .....  

RE: INDICATORS OF VISITOR IMPACTS ON NATURAL AREAS

The Ministry of Tourism is working towards sustainable tourism in natural areas and is currently undertaking a number of projects aimed at achieving this overall goal. One of the projects involves the development of indicators of visitor impacts on natural area or natural attraction. The Ministry has contracted Jonet Ward of Lincoln Ventures Ltd, Lincoln University to initiate this particular project. Ruth Beanland from Massey University has been sub-contracted to assist.

The first step in the process of developing indicators requires an understanding of the level of visitor use and associated impacts, and the degree to which these parameters are currently being monitored or surveyed.

The purpose of this letter is therefore to make initial contact with all Department of Conservation conservancies and some local authorities that we consider may have information to assist us. We would appreciate it if you could answer the questions outlined below. However, please add any additional comments or responses you feel are relevant.

1. Is there, or has there been any regular monitoring or one-off surveys of visitors to and/or their impacts on natural areas or major natural attractions within your jurisdictional boundaries?

2. If yes:
   a. Which areas and/or natural attractions were surveyed and/or are being monitored and for what purpose?
   b. What parameters are/were being used? (For example, visitor perceptions, adequacy of facilities, litter, water quality, erosion, trampling, vegetation disturbance, noise).
   c. Which agencies or community groups (including tangata whenua) were or are involved?

3. Would your organisation like to continue to be involved in an advisory group to the Ministry in relation to this project?

Please reply to Jonet Ward or Ruth Beanland by mail/e-mail/fax/telephone (contact details attached) by Tuesday 26 April, 1994. We appreciate that this is short notice and apologise for any inconvenience. However, we are not looking for detailed replies as this is merely a preliminary enquiry. To assist you, we will therefore follow up any outstanding replies by telephoning you on the 26 April 1994.

Thank you very much for your assistance.

Yours sincerely

Robert Sowman
Ministry of Tourism
CONTACT DETAILS

Dr Jonet Ward
Environmental Scientist
Lincoln Environmental
PO Box 84
Lincoln University
CANTERBURY
Ph. 03 3252811
Fax. 03 3253841
E-Mail WardJ@Lincoln.ac.nz

Ruth Beanland
Lecturer
Department of Planning
Massey University
Private Bag 11222
PALMERSTON NORTH
Ph. 06 3504344
Fax. 06 3505689
E-Mail R.A.Beanland@massey.ac.nz

Development of Environmental Indicators for Tourism in Natural Areas: A Preliminary Study
APPENDIX D
EXAMPLES OF NATURAL ATTRACTIONS IN NEW ZEALAND BY CATEGORY

(Note that the following lists are examples only and are not all inclusive nor complete at this stage)

1. **Major Natural Attractions - International Visitors**
   - Whakarewarewa Thermal Area
   - Milford Sound
   - Glaciers - Franz Josef & Fox
   - Waitomo Caves
   - Mount Cook Village

2. **Natural Attractions based on Flora, Fauna and Landscape Features**
   - Taiaroa Heads Albatross Colony
   - Cape Kidnappers Gannet Colony
   - Kapiti Island Nature Reserve
   - Kaikoura Peninsula Seal Colony
   - Okarito Heron Colony
   - Kaikoura Whale Watching

3. **Major Natural Attractions for Specific Recreation “Experiences”**
   3.1 **Major tramping tracks on land administered by the Department of Conservation:**
   - Abel Tasman
   - Milford
   - Routeburn
   - Kepler
   3.2 **Other popular tracks on land administered by the Department of Conservation estate:**
   - Tongariro Crossing
   - Heaphy
   - Pinacles/Webb Creek (Coromandel)
   - Rees-Dart
   - Lake Waikaremoana
   - Norther Circuit/Rakiura (Stewart Island)
   - Travers/Sabine (Nelson Lakes)
   3.3 **“Wilderness” Tracks on land administered by the Department of Conservation**
   3.4 **“Managed” Tracks on land not administered by the Department of Conservation**
   3.5 **“Wilderness” Tracks on land not administered by the Department of Conservation**
   3.6 **Major Attractions for “adventure tourism” on land not administered by the Department of Conservation**
   3.7 Skifields
   3.8 Recreational Fishing Areas
   3.9 Natural Areas Hosting Special Recreational Activities/Events
Development of Environmental Indicators for Tourism in Natural Areas: A Preliminary Study
<table>
<thead>
<tr>
<th>Type of accommodation or shelter</th>
<th>Vegetation clearance or damage</th>
<th>Soil erosion and/or compaction</th>
<th>Wildlife disturbance or habitat destruction</th>
<th>Firewood collection and campfires</th>
<th>Solid wastes</th>
<th>Water pollution</th>
<th>Noise</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resorts, Hotels Construction</td>
<td>Site clearance</td>
<td>Short term during construction</td>
<td>Habitat cleared noise</td>
<td>Construction rubbish builders rubble</td>
<td>Construction plant</td>
<td>Construction site and plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuing</td>
<td>Tracks etc</td>
<td>Unsealed tracks etc</td>
<td>Shyer species leave area</td>
<td>Collected elsewhere if used</td>
<td>Garbage treated sewage</td>
<td>Soilage increased nutrients</td>
<td>Machinery and motors</td>
<td>Conspicuous buildings and infrastructure; large vehicles</td>
</tr>
<tr>
<td>Fixed car or caravan camps</td>
<td>Site clearance initially and continuing, tracks etc</td>
<td>If ungrassed and increasing with use</td>
<td>Habitat clearance shyer species leave area</td>
<td>Large area often denuded</td>
<td>Garbage litter toilets</td>
<td>Soilage increased nutrients, bacterial</td>
<td>Generators car engines, chainsaws, radios, voices</td>
<td>Vehicles, caravans, large tents, equipment, campfires</td>
</tr>
<tr>
<td>Overnight car/4WD camps</td>
<td>Increasing with use</td>
<td>Increasing with use</td>
<td>Depends on frequency of use</td>
<td>Large campfires common</td>
<td>Litter human wastes</td>
<td>Bacterial soap</td>
<td>Car engines, chainsaws, radios, voices</td>
<td>Cars, large tents, campfires</td>
</tr>
<tr>
<td>Horse/Hiker huts</td>
<td>Local site clearance, trampling</td>
<td>Localised depends on soil type etc</td>
<td>Minor localised</td>
<td>Large area often affected regular large campfires</td>
<td>Litter, horse dung, human wastes</td>
<td>Bacterial</td>
<td>Saws, voices</td>
<td>Huts, cleared paddocks, campfires</td>
</tr>
<tr>
<td>Boat access shore sites</td>
<td>Increasing with use</td>
<td>Bank erosion</td>
<td>Minor localised</td>
<td>Large area often affected, regular large campfires</td>
<td>Litter, fish guts, human wastes</td>
<td>Petroleum residues</td>
<td>Outboard motors, voices</td>
<td>Boats, large tents, floss, clearance</td>
</tr>
<tr>
<td>Often used bush camps</td>
<td>Localised, new tent sites</td>
<td>Localised, depends on soil type etc</td>
<td>Minor, localised</td>
<td>Depends on vegetation type large area may be affected</td>
<td>Some paper, human wastes</td>
<td>Bacterial, soap</td>
<td>Voices</td>
<td>Small tents, fires</td>
</tr>
<tr>
<td>Single-use camps &amp; bivouacs</td>
<td>Minimal or none</td>
<td>Generally none</td>
<td>Temporary or none</td>
<td>Minimal or none</td>
<td>Generally none</td>
<td>Generally none</td>
<td>Minimal or none</td>
<td>Minimal and temporary</td>
</tr>
</tbody>
</table>
Table 2: Environmental impacts and recreational activities in natural areas (Buckley and Pannell, 1990)

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Accommodation or shelter</th>
<th>Travel &amp; transport in recreation area</th>
<th>Additional impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principally sporting &quot;excitement&quot; activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>downhill skiing</td>
<td>resorts or lodges</td>
<td>skis</td>
<td>ski lifts</td>
</tr>
<tr>
<td>kayaking</td>
<td>tents</td>
<td>kayaks</td>
<td>-</td>
</tr>
<tr>
<td>sailing</td>
<td>yachts</td>
<td>yachts</td>
<td>-</td>
</tr>
<tr>
<td>biking</td>
<td>tents or lodges</td>
<td>cars, bikes</td>
<td>-</td>
</tr>
<tr>
<td>climbing</td>
<td>tents or huts</td>
<td>cars, feet</td>
<td>-</td>
</tr>
<tr>
<td>caving</td>
<td>caves or camps</td>
<td>cars, feet</td>
<td>cave fauna</td>
</tr>
<tr>
<td>hunting (game)</td>
<td>hotels or huts</td>
<td>ORV's or feet</td>
<td>loss of wildlife</td>
</tr>
<tr>
<td>shooting (birds)</td>
<td>hotels or camps</td>
<td>cars, boats</td>
<td>loss of wildlife</td>
</tr>
<tr>
<td>ORV’s</td>
<td>hotels or camps</td>
<td>ORV's</td>
<td></td>
</tr>
<tr>
<td>Principally naturalist &quot;contemplation&quot; activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>resort stays</td>
<td>resorts, hotels</td>
<td>cars, coaches</td>
<td>ill-formed sightseers;</td>
</tr>
<tr>
<td>plane safaris</td>
<td>resorts, hotels</td>
<td>planes</td>
<td>vandalism to archaeological,</td>
</tr>
<tr>
<td>coach tours</td>
<td>resorts, hotels</td>
<td>coaches</td>
<td>cultural and natural heritage</td>
</tr>
<tr>
<td>4WD safaris</td>
<td>tents, camps</td>
<td>4WD vehicles</td>
<td>areas</td>
</tr>
<tr>
<td>horse safaris</td>
<td>tents</td>
<td>horses</td>
<td></td>
</tr>
<tr>
<td>canoe safaris</td>
<td>tents or huts</td>
<td>canoes</td>
<td></td>
</tr>
<tr>
<td>ski touring</td>
<td>tents or huts</td>
<td>skis</td>
<td></td>
</tr>
<tr>
<td>bushwalking</td>
<td>tents or huts</td>
<td>feet</td>
<td></td>
</tr>
<tr>
<td>birdwatching etc</td>
<td>various</td>
<td>feet</td>
<td></td>
</tr>
<tr>
<td>fishing</td>
<td>various</td>
<td>boats, powered or otherwise</td>
<td></td>
</tr>
<tr>
<td>Means of transport/travel</td>
<td>Vegetation clearance or damage</td>
<td>Soil erosion or compaction</td>
<td>Wildlife disturbance, shooting or habitat destruction</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Lights plans, helicopters</td>
<td>Airstrips only</td>
<td>Airstrips only</td>
<td>Depends on speed, altitude, frequency of flights</td>
</tr>
<tr>
<td>Bus or car on road</td>
<td>Roads and verges cleared</td>
<td>Compaction and erosion on unsealed roads</td>
<td>Noise depends on traffic density; roads can act as barriers; road kills</td>
</tr>
<tr>
<td>Car or 4WD on tracks</td>
<td>Tracks cleared; tend to be widened and new tracks cut</td>
<td>Dust, gully erosion and compaction widespread</td>
<td>Road kills, noise, shooting</td>
</tr>
<tr>
<td>ORV's off track</td>
<td>Severe and extensive vegetation damage</td>
<td>Erosion widespread, depends on terrains and soil type</td>
<td>Widespread noise disturbance, ORV's used for shooting</td>
</tr>
<tr>
<td>Mountain bikes</td>
<td>Less severe than ORV's</td>
<td>Localised in heavy use areas</td>
<td>Disturbance in heavy use areas</td>
</tr>
<tr>
<td>Horses</td>
<td>Tramping on horse trails</td>
<td>Localised, trails and holding paddocks</td>
<td>Minimal, unless riders rowdy or shooters</td>
</tr>
<tr>
<td>Hiking</td>
<td>Tramping on heavily used trails</td>
<td>Localised on heavily used</td>
<td>Generally minimal</td>
</tr>
<tr>
<td>Power boats</td>
<td>Campsites, shoreline and aquatic vegetation</td>
<td>Not applicable</td>
<td>Noise, fishing and shooting</td>
</tr>
<tr>
<td>Unpowered watercraft</td>
<td>Generally none</td>
<td>Not applicable</td>
<td>Fishing only</td>
</tr>
</tbody>
</table>