NEGATIVE EFFECTS OF WILDLIFE TOURISM ON WILDLIFE

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WILDLIFE TOURISM RESEARCH REPORT SERIES: NO. 5
Status Assessment of Wildlife Tourism in Australia Series

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This series presents research findings from projects within the Wildlife Tourism Subprogram of the CRC. The Subprogram aims to provide strategic knowledge to facilitate the sustainable development of wildlife tourism in Australia.

Status Assessment of Australian Wildlife Tourism, Editorial Team: Dr Karen Higginbottom, Ms Kelley Rann, A/Prof Derrin Davis

This report is one in a series comprising a status assessment of wildlife tourism in Australia. It comprises the initial stages of research undertaken by the Wildlife Tourism Subprogram of the CRC. Reports in this series cover various disciplinary perspectives (visitors, economics, hosts, wildlife management) as well as various subsectors (such as zoos, bird watching and hunting). Together, the reports identify the current status and key issues facing Australian wildlife tourism, and make recommendations to enhance its sustainability.

National Library of Australia Cataloguing-in-Publication Data

Green, Ronda

The negative effects of wildlife tourism on wildlife

Bibliography.
ISBN 1 876685 31 X.

1. Ecotourism - Environmental aspects - Australia. 2. Wildlife conservation - Australia. 3. Wildlife-related recreation - Australia. I. Higginbottom, Karen. II. Cooperative Research Centre for Sustainable Tourism. III. Title. (Series : Wildlife tourism research report (Cooperative Research Centre for Sustainable Tourism) ; no. 5).

338.479194

EXECUTIVE SUMMARY

Aims

This report reviews the mechanisms by which wildlife tourism can have negative effects on wildlife and the management practices that can be used to mitigate these effects, with a focus on practices relevant to Australia. It identifies areas of research most urgently needed to determine the effects that may result from wildlife tourism and related activities. It then recommends some basic guidelines for management techniques and processes to minimise negative effects while continuing to cater to visitor satisfaction and other needs of the tourism industry.

Key Issues

Wildlife tourism is often considered environmentally friendly because it is expected that those who want to see wildlife will also be concerned with conservation and animal welfare. Further, there are many ways in which wildlife tourism can actually make positive contributions to conservation. However, it also has the potential to have various negative effects on animal populations, behaviour and/or welfare. These need to be understood if they are to be effectively minimised. A search of local and international literature, coupled with interviews with personnel from Australian government conservation agencies, identified many potential and actual problems.

The negative effects of wildlife tourism and related human activities on wildlife can be grouped into three main categories: (1) disruption of activity, (2) direct killing or injury, and (3) habitat alteration (including provision of food). The extent of negative impacts on wildlife can vary enormously depending on species, life-cycle stages, habitats and other variables.

Examples of disruption of activity include spotlighting, noisy activities, and the approach of tourists towards animals that are foraging or caring for their young. When a human disrupts the activities of wildlife, the response will be either avoidance behaviour where the wildlife will flee or hide, habituation where there is a learned lack of

response to humans to the point of seeming to ignore their presence, or attraction – usually in expectation of food. The extent to which an animal is likely to be affected by human activities will be influenced by a number of factors. These include the amount and type of previous contact with humans, the means of transport used by visitors, the predictability of the human activity, the openness of habitat, the nature of the animal's activity and whether it has dependent offspring. Far too little is currently known about the effects of hand-feeding and spotlighting, and the effects of tourism activity generally on shy cryptic species.

Death or injury can occur as the result of unintentional events such as road accidents, or from intentional acts of hunting, fishing and collecting. Hunting, fishing and collecting (whether by tourists or souvenir sellers) require careful regulation formulated under advice from wildlife ecologists familiar with the practices and the animals in question. The unintentional trampling of wildlife (e.g. eggs of ground-nesting birds), deliberate killing for safety reasons, (e.g. snakes), the use of insecticides for tourist comfort, and the burning of forest understorey for firebreaks (especially during breeding season) can also directly cause wildlife mortality.

The most obvious occurrence of habitat alteration happens when land is cleared or modified to make room for the infrastructure needed for tourism activities. Changes to habitat also occur from off-road vehicle damage and humans trampling on vegetation. Intentional and accidental provision of food can also be seen as a form of habitat alteration. These changes can result in significant increases or decreases in population numbers, reduction of protection from predators and the weather, or reduction of prey species. If one species increases markedly in numbers, this may have negative impacts on other species within the ecosystem. Some hand-fed animals may become aggressive and a danger to tourists.

Determining the magnitude of impacts and deciding whether they are positive, negative or neutral can be a difficult task. For example, what is positive for one species may be negative or neutral for another or the ecosystem in general. What is positive in an ecological sense may be negative in terms of effects on species' behaviour. The assessment of impacts will also vary according to the goals of the human activity

(for example, whether close approach or natural behaviour is deemed more important), the means of approach and the other activities carried out at the site. Human activity may also induce changes on other species that are not directly involved in the wildlife tourism experience.

Management actions designed to mitigate negative effects of wildlife tourism on wildlife can focus on either wildlife or visitors, and can use a variety of different methods. In most cases, it will be appropriate to focus on management of visitors or operators, in terms of their numbers, spatial or temporal distribution, behaviour, expectations or attitudes. The principle methods that can be used are: physical structures to 'harden' the environment, regulation (by governments or industry), economic instruments, education, marketing, use of environmentally responsible operators, and cooperative agreements between management agencies and operators. All these methods are used in Australia and elsewhere in relation to wildlife tourism, but available research does not allow clear conclusions to be drawn about their relative merits. There are widespread views that greater investment in educational approaches and in industry self-regulation are desirable. However, the most effective mix of management measures in any particular situation will depend on a number of factors such as management objectives, magnitude of likely effects, and availability of suitable expertise.

Management is not confined to the management actions themselves, but should also include monitoring and evaluation. There are a number of well-established principles of environmental monitoring that should be considered in the design of monitoring programs, but there is a need for a user-friendly guide for Australian conditions and specifically relating to the tourism industry. In the real world, there is also a need for a process to take into account the often conflicting views of different stakeholders. A number of models have been proposed by various authors to bring all these elements together into a logical management framework. Models such as TOMM, VIMM and LAC all seem to have merits but their effectiveness has not yet been established clearly.

Conclusions and Recommendations

There is a considerable body of information that needs to be disseminated to the tourism industry and to conservation managers, either directly relating to the Australian situation or with potential for adapting to conditions here. There are also gaps in our knowledge that appear to be urgent research priorities. These especially include the effects of hand-feeding on both target and non-target wildlife, effects of spotlighting, and effects of human presence on small cryptic animals that are generally unnoticed by tour operators or tourists.

Management processes that identify potential and actual negative effects, and implement actions to correct them, are critical to sustainable wildlife tourism, particularly if there is further growth of this sector. Ideally monitoring should begin before a new wildlife tourism activity is set up and should occur in an ongoing manner, but to date there are few examples of this occurring. If the use of monitoring is to be more widespread, user-friendly monitoring techniques and guidelines must be developed and information about their use disseminated. In some cases, monitoring may be unable to detect negative effects (either because of inadequate monitoring efforts or inherent difficulties in monitoring particular species): in such cases a precautionary approach should be taken where there is significant cause for concern. Some species and situations may need to be precluded from wildlife tourism because of the difficulty of managing impacts or the conservation value of the animals concerned. In most cases of new wildlife tourism developments or activities, an adaptive management approach is desirable. There are no 'prescriptions' about what form of management works best, although generally a complementary mix of measures should be used, with the appropriate choice of measures depending on the circumstances. There should be wide dissemination of the different management options and factors that should be considered in deciding which to adopt, written in a user-friendly format.

Management should occur within a comprehensive planning and evaluative framework. Although much has been written about different management models, the key points are straightforward:

- Set clear management objectives.

- Conduct monitoring to test whether management objectives are being achieved.

- Build in an effective feedback mechanism to ensure management is adjusted according to feedback from monitoring.

- Build in effective mechanisms for stakeholder involvement.

Where possible, management should also occur as a partnership between operators, management authorities and local stakeholders, and where possible even tourists. All can, in theory, participate in setting of objectives, monitoring and implementation of management actions.

In practice, resource constraints will mean that management efforts must be prioritised. Knowledge extrapolated from research and from wildlife and local expertise should be used to determine these priorities. In general, highest priority should be given to species that are threatened or otherwise of conservation concern, and to activities that have the potential to have a major impact on animal reproduction or survival (in Australia, probably most likely to occur when tourism is focused on breeding colonies). In the meantime, further research to help us to understand and predict likely impacts, and to assess the likely effectiveness of different management approaches, should be conducted.

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ABSTRACT

Wildlife tourism is often considered environmentally friendly, but it has the potential to cause various negative effects on populations, behaviour and welfare of wildlife. A search of local and international literature, coupled with interviews with personnel from government conservation agencies, identified many potential and actual problems. These effects can be grouped into: disruption of activity, direct killing or injury, and habitat alteration (including provision of food). The magnitude and seriousness of negative effects can vary enormously depending on species, life-cycle stages, habitats and other variables. Management processes that identify potential and actual negative effects and implement actions to correct them are critical to sustainable wildlife tourism, particularly if there is further growth of this sector. Management actions designed to mitigate negative effects of wildlife tourism on wildlife typically focus on management of visitors, and can use a variety of different methods. Monitoring of wildlife that could be affected by wildlife tourism activities is particularly critical to sustainability, and should incorporate well-established statistical principles where possible. However there is a need for a user-friendly guide to wildlife monitoring for Australian conditions and specifically relating to the tourism industry. Some species and situations may need to be precluded from wildlife tourism altogether. Overall, there is a need for more comprehensive and better funded management and monitoring of the effects of wildlife tourism on wildlife if we are to assure its long-term sustainability.

1. INTRODUCTION

This report is one of a series comprising a status assessment of Australian wildlife tourism, an initial stage of the research of the wildlife tourism subprogram of the CRC for Sustainable Tourism. It reviews the mechanisms by which wildlife tourism can have negative effects on wildlife and the management practices that can be used to mitigate these effects, with a focus on practices relevant to Australia. It then recommends steps to minimise these negative effects. This report feeds into an overall assessment of Australian wildlife tourism presented in Higginbottom *et al*. (2001a).

Wildlife tourism is that component of nature-based tourism that is based on non-domesticated animals, whether in captivity or in their natural habitats (Higginbottom *et al*. 2001a). Wildlife tourism globally attracts many millions (probably billions) of visitors and has been identified as an important growth area within some regions (reviewed by Higginbottom *et al*. 2001a). In Australia there are more than 1,196 enterprises that provide organised wildlife tourism opportunities, with probably well over 10 million annual participants (*ibid*). Some sectors of wildlife tourism such as whale watching, have clearly experienced substantial recent growth, while the evidence for most sectors is less clear cut. Nevertheless there is a clear trend towards developing wildlife viewing in a wider range of environments and focused on a wider range of species, which is also reflected in Australia.

To put the issue of negative effects of wildlife tourism into context, it should be recognised that wildlife tourism can also have positive effects on wildlife and their habitats. Burger *et al*. (1995) refer to a 'growing interest in ecotourism as a means of conserving and preserving wildlife and habitat.' Davies (1990) comments that 'it seems tragically almost ironic that the demands of tourism development and environmental protection are frequently portrayed as antagonistic, and widely perceived to be in inevitable conflict.' Manidis Roberts Consultants (1997) have argued that emphasising what is desired in natural-area tourism rather than concentrating only on the risks can lead to more creative and positive outcomes. A separate report (Higginbottom *et al*. 2001b) reviews the actual and potential positive effects of wildlife tourism, and should be read in

conjunction with the present report to provide a balanced assessment of the effects of wildlife tourism on wildlife. These positive effects include principally: creating an economic incentive for conservation, providing a source of revenue and/or labour for conservation, and education of visitors towards conservation objectives. There are examples of all these types of benefits in Australia, but it is impossible to quantify their significance based on currently available information. An overall assessment of the impacts of wildlife tourism on wildlife requires simultaneous examination of both negative and positive effects, and is provided in Higginbottom *et al*. (2001a). It is concluded that it is not possible to quantify the current balance between negative and positive effects in any country, although it seems that in Australia there is probably a small net positive effect. Further, as also shown later in the present report (section 3.1.2), Higginbottom *et al*. (2001b) report that there was consensus among key informants in senior posts within government agencies that the net effects were positive, principally because of perceived strong educational benefits.

Further, compared with other land uses, wildlife tourism can be relatively benign. Biodiversity is in many cases likely to be far more reduced by agriculture and urbanisation than by well-run wildlife tourism. Huxley (1994) notes that where all tourism is excluded from natural areas other more damaging industries may move in. Publications on the conservation of biodiversity (e.g. Yen and Butcher 1997, Barthlott and Winiger 1998) usually stress loss of habitat as the major factor causing decline, with introduced species, pollution and other factors rating considerably above tourism of any kind. Many in the wildlife tourism industry are concerned with wildlife conservation and welfare, whether for ethical or business reasons. Lubeck (1990) acknowledges 'a growing number of innovative and committed tour operators who are working to implement a higher environmental standard in their business practices.' In Australia many tourism operators are opting to apply for ecotourism accreditation with the Nature and Ecotourism Accreditation Program (NEAP), part of which addresses impacts on wildlife. To conduct such operations properly however, knowledge of actual and potential negative effects of their activities on wildlife and habitats is needed.

Wildlife tourism in Australia is highly diverse in terms of species, habitats, geographical location and types of activity involved

(Higginbottom *et al*. 2001a). In terms of numbers of commercial operators, the most common types of activities are nature-based tours (land, freshwater or marine-based) that include a wildlife component. Wildlife tourism involving free-ranging animals also occurs as an adjunct to or as the key attraction for accommodation based experiences, such as farmstays, lodges and resorts, and bird observatories. It comprises the principal focus of a number of specialised tours and also of some marine experiences built around snorkelling, diving, or reef viewing. Wildlife tourism components are also built into many large bus tours. Many of these tours are based on free-ranging animals occurring in protected areas (terrestrial or marine). In addition, a large but unknown number of tourists in Australia encounter wildlife as independent travellers, often in protected areas but also in urban areas and on private rural land. In terms of numbers of participants, captive wildlife tourism is the largest sector of Australian wildlife tourism, with more than 8 million visitors per year. Such attractions include zoos, wildlife parks, theme parks, aquaria, mobile wildlife exhibitors and farms cultivating native or exotic wildlife. Consumptive forms of wildlife tourism in Australia include substantial involvement of tourists in fishing, and a small hunting tourism sector. Altogether more than 260 kinds of animals, including 221 native species, are featured in advertising for Australian wildlife tourism activities. Among enterprises based on free-ranging animals, at least 135 kinds of animals are involved, 120 of those being native species.

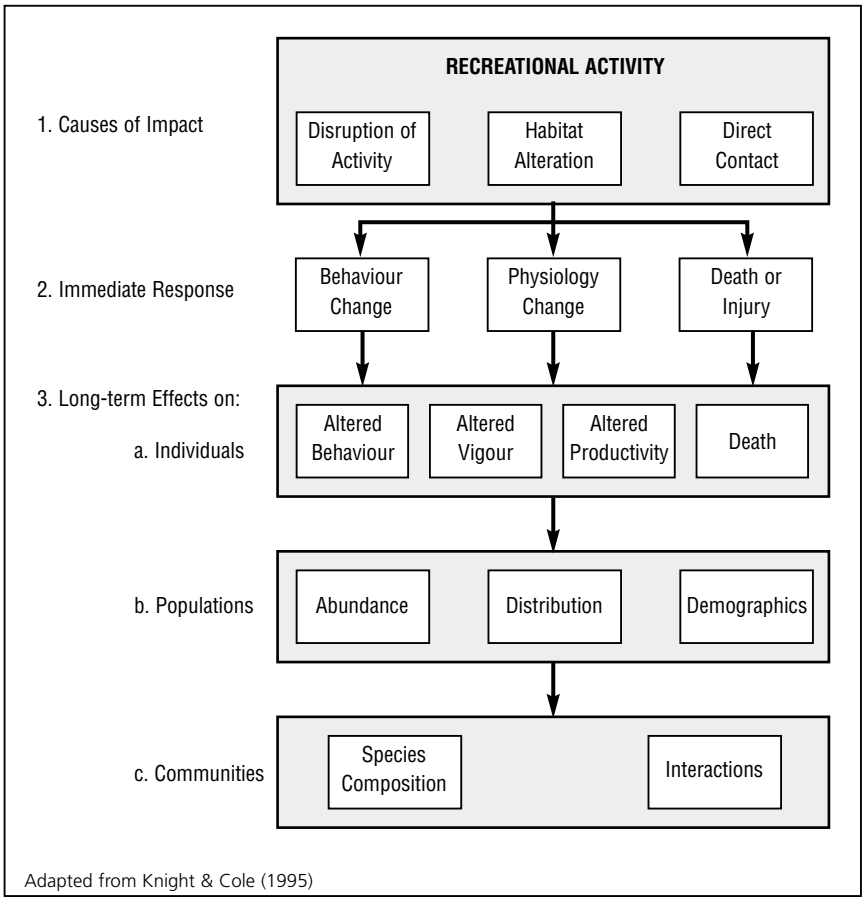
This report deals with wildlife in their natural habitats, as negative effects of wildlife tourism on captive wildlife are rather different (relating principally to animal welfare issues) and are covered briefly by Tribe (2001) as part of the present report series. Most of the examples used relate to non-consumptive use of terrestrial animals, as marine wildlife, hunting and fishing respectively have been partially covered by other reports in this series (Bauer and Giles 2001, Birtles *et al*. 2001, Gartside 2001).

Tourism based on free-ranging animals brings with it a potential threat to the persistence and well-being of the wildlife populations involved. This is of concern not only for conservation reasons, but also poses a threat to the sustainability of associated tourism operations. In Australia, these concerns are particularly justified given the high

conservation value of our wildlife and ecosystems and the high proportions of already-threatened species (see Higginbottom *et al*. 2001a for a review). Thus it is crucial that any further development of wildlife tourism based on free-ranging animals proceeds with awareness of the potential threats to wildlife and how to mitigate them.

Negative effects of wildlife tourism on free-ranging wildlife can occur at a hierarchy of interconnected levels, from the community or species to the individual animal (Figure 1). In terms of conservation, effects are of concern only if they influence the viability of populations, communities or species. Extinction is the most urgent problem for conservation, while local extinction (extinction of a single population) will contribute towards global extinction, but its seriousness will depend on the vulnerability of the species as a whole. However these higher level effects generally occur as a result of the combined effects on reproductive success of individuals (via change in breeding success or survival). A change in reproductive success may in turn either be caused directly by a recreational activity, or may be mediated by a behavioural or physiological change. Effects on the survival, reproduction, health or stress-levels of individuals can also be causes for concern on animal welfare grounds even where they do not translate into population-level effects. They can also act as early warning signs of pressures that could lead to a decline in survival and reproduction causing serious population decline.

Figure 1: A conceptual model of the responses of wildlife to disturbance



Adapted from Knight & Cole (1995)

The following example illustrates the complexity of these relationships. It may seem no big deal if a tawny frogmouth spreads its wings and flies out of sight after being viewed for a minute or two under the spotlight. However if such occurrences are frequent it may result in: (a) depletion of energy reserves, (b) diversion of time from necessary activities, (c) temporary impairment of vision or (d) a permanent move away from favoured foraging or breeding areas. Any of these could lead to a decrease in the amount of prey captured

and eaten by local frogmouths, which in turn could lead to a decline in the local population. Thus the immediate responses of animals to tourists may prompt changes in short-term or long-term behaviour and physiology. Such changes have the potential to lead to population decline and possible local extinction, or to population explosions, sometimes to the detriment of other species. Conversely, a negative effect of wildlife tourism on wildlife may be found without the intervening mechanism being clear. For example, there seems to have been strong circumstantial evidence that tourism involving feeding of bottlenose dolphins at Monkey Mia in the past caused unusually high levels of mortality among young dolphins (Wilson 1994). A range of mechanisms may have been responsible, and it is not possible to distinguish between them. These include: increased exposure to polluted waters occurring around the interaction site, exposure to human pathogens, reduction in vigilance to predation, and nutritional deficiencies in the food provided.

Even deciding whether responses of animals to humans are positive, negative or neutral is not always straightforward (as discussed by Whittaker and Knight 1998), and confusion can ensue when discussing them without clear goals in mind for either the animals or for the tourists. In this paper we are concerned primarily with effects on the animals themselves. This must however be considered in conjunction with the needs of the tourism industry (reliable viewing of animals, photographic opportunities etc.), as in reality compromise is common and alternative land-uses may be even more destructive to wildlife. Different kinds of tourists anticipate different kinds of behaviour from animals. Those who enjoy a wilderness experience may not appreciate the tameness of animals begging for food, although the same behaviour can delight others. Hunters may wish the animals to fear humans sufficiently to make their sport challenging, while photographers and bird-watchers want to get close enough to see details clearly. Likewise, deciding on positive goals for the animals is not always clear-cut. A positive response by one species may cause a negative response in a competing or prey species, or even ultimately the ecosystem as a whole. From a conservation perspective, as well as for many nature-lovers, habituation in protected areas may often be the ideal, as the animals do not lose energy in taking flight every time a human is detected. There are times however when habituation can be dangerous. An

animal habituated to traffic may be less likely to move quickly off the road when a vehicle is approaching, and a migratory bird habituating to birdwatchers in one geographical locality may be more vulnerable to hunters in another. Conservation goals may also be either in harmony or in conflict with animal welfare goals. For instance, protecting the young of a common species in a natural area from predation or normal levels of starvation may seem a worthwhile animal welfare goal (at least in the short-term) but may be counter to the aim of preserving a naturally-functioning ecosystem. Supplementary feeding of rare species during exceptionally severe droughts, or when their natural food has been decreased by human activity, may on the other hand be in line with both welfare and conservation goals.

Whether or not human-induced behavioural or population changes constitute a conservation problem depends partly on the setting. Changes within a wilderness area are always of concern because: (a) we still understand so little of the complexities of species interactions in nature and the long-term effects of such changes, (b) if we are ever to increase substantially our knowledge of native ecosystems we need to leave as many as possible in as natural a condition in which to conduct relevant research, and (c) there are various philosophical reasons for preserving wilderness and its wildlife component in as natural a state as possible. Changes in habitats that have already been altered are less clear-cut. Increases in kangaroo, lorikeet or bandicoot numbers on a farm-stay property, eco-lodge or campground may lead to conservation or welfare problems, but we cannot assume they will necessarily do so. This is especially so when viewed in context with effects of habitat-clearing, grazing by domestic animals, altered fire frequencies or the use of pesticides on the same property.

Are the needs of wildlife and the needs of the nature-loving tourist likely to be in conflict or in harmony? Can the tourism industry rest assured that by catering to one it will automatically cater to the other? It seems likely that satisfaction levels of wildlife tourists will be higher in places where wildlife is abundant, healthy and behaving in a reasonably natural fashion – although there has been little research on this topic (Moscardo *et al*. 2001). Thus in many cases we would anticipate a positive association between visitor satisfaction and wildlife conservation. Catering in particular to the needs of those

wanting a 'wilderness experience' or a feeling of being 'in touch with nature' will presumably often assist in preserving habitat for wildlife. At the same time, preserving wildlife and its habitat should cater to the needs of many, if not most wildlife tourists. This is an agreeable situation, but we should not become too confident that by attending to one we are also necessarily catering to the other. Primitive hiking for instance may be seen as more 'natural' than walking on constructed trails, and travel by all-terrain-vehicles more so than car touring (Clarkson 1984), but the former in each case has more potential for negative effects on wildlife and their habitats (see Sections 3.2 and 3.4). A reasonable compromise is often possible, but where serious conflict exists, it should be realised that although visitor satisfaction might be achieved in the short-term by disrupting native ecosystems, it may ultimately be lowered as these ecosystems deteriorate and ultimately collapse. Fox (1982) also cautions that new visitors to an area may report high satisfaction because of scenic and other values, not realising that some wildlife species have seriously declined or even become locally extinct. He thus argues that visitor satisfaction alone can be a poor indicator of habitat quality or of the effects of tourist activity on wildlife.

Many authors see tourism, in general, as a threat to the natural environment. Croall (1995) for instance remarks on a 'worldwide explosion in tourism over the last 30 years, with devastating consequences for the environment.' Other typical comments in the literature include: 'In all parts of the world the conflicts between natural areas and human needs increasingly involve tourism' (Ceballos-Lascurain and Johnsingh 1995); 'Recreational disturbance is quickly becoming a dominant structuring force in many wildlife communities' (Gutzwiller 1995); or even 'The recreation industry deserves to be listed on the same page with interests that are cutting the last of old-growth forests' (Oelschlaeger 1995).

Wildlife tourism is often considered environmentally friendly, because people who want to see wildlife are expected to also be concerned about conservation and animal welfare. In some ways however, the wildlife tourist has potential to do more damage than the general tourist. Wearing and Neil (1999) state 'One of the chief criticisms of ecotourism [which over-laps with wildlife tourism] is that it threatens to destroy the environment which it is trying to protect.' Ream (1979)

warns us 'the problem is harassment of wildlife ... It is what photographers, skiers and bird watchers do – *the good guys*.' Huxley (1994) comments that sometimes the people who know what they are looking for are the ones who do the greatest harm. Anderson and Keith (1980) lament that 'many well-meaning observers still retain what Wilkes (1977) terms 'the myth of the non-consumptive user', which is that non-exploitative uses of wildlife resources have trifling effects on such organisms.' Burger and Gochfield (1993) observed that tourists often: get closer to nesting birds for identification regardless of their effect on the bird; intentionally flush a rare bird; and occur in large and noisy groups. Burger *et al*. (1995) note that bird-watchers visiting a new area want particularly to see the rare and shy species, which are likely to be also the most vulnerable. Lubeck (1990) criticises many wildlife safari operators in East Africa who 'continue *business as usual*, leaving behind a peculiar trail of destruction, of garbage, sewage and ground up terrain.' Even very well-organised operations cannot guarantee zero impact on a fragile environment. 'A footprint in the Antarctic moss could last for decades' (Masson 1990). Sometimes effects are immediate and obvious, such as cranes flying into powerlines to escape human presence (Anderson 1995), but others can be subtle, with effects accumulating gradually and ultimately becoming serious.

The principle aims of this report are to:

- review the literature (both Australian and overseas) for demonstrated kinds of negative effects of wildlife tourism and related activities on wildlife;

- identify other negative effects on wildlife that may result from wildlife tourism and related activities in Australia;

- identify areas of research most urgently needed to determine negative effects;

- offer some basic guidelines for management techniques and processes to minimise negative effects while continuing to cater to visitor satisfaction and other needs of the tourism industry; and

- identify areas of research most urgently needed to elucidate management options to minimise such effects.

Section 2 of this report explains the methods used. Section 3 surveys the various kinds of negative effects of wildlife tourism on wildlife and wildlife habitats, with emphasis on Australia or situations in other countries that appear to have relevance to those of this country. Section 4 offers a review of management techniques to mitigate some of these effects. Gaps in our current knowledge are identified in both Section 3 and Section 4. General recommendations based on these are presented in Section 5.

Despite its focus on negative effects, this report should not be seen as an argument to prevent or seriously limit responsible wildlife tourism (except in certain areas of particular vulnerability). It is intended rather as a contribution to guidelines on how best to develop the industry without destroying the resources on which it is based, including the wildlife species on which tourism focuses and those features of their habitats on which they depend. The report also identifies threats to components of the ecosystems less obviously relevant to the species of major tourism interest, but which responsible operators should endeavour to avoid. It is to be hoped that information herein will also assist in focusing on major directions for future research to refine our ability to achieve such a goal.

2. METHODS

2.1 Literature Survey

The principal methodology used for this report was extensive literature research, focusing on published literature from around the world and including some unpublished Australian documents provided principally by government sources. Where possible, literature (both published and unpublished) on wildlife tourism in Australia was sought. In the end, less than 15% of the literature read focused on Australian ecosystems, and less than 30% on wildlife tourism as such. However, many of the non-Australian reports involved animals related to or even the same species as those in Australia (especially water-birds and marine mammals).

Although our literature survey was quite extensive, it had its limits. Many minor but potentially important publications around the world are not easy to locate, although we have requested and received many of these. There is certain to be much 'grey literature' sitting on the shelves of government agencies, environmental agencies and non-government organisations that because of time constraints we have not reached, and much more of which we remain unaware. There are also many records held by researchers and students who have not published because of inadequate sample sizes, premature termination of a study, non-significant results or simply (and frequently) lack of time. Many of these would have been of interest if only to suggest further important avenues of concern for future study.

Another difficulty in reviewing the literature on tourism is that it is not always possible to determine whether the human activity observed and described is strictly tourism, and at times even more difficult to decide if it qualifies as wildlife tourism. For consideration of effects on wildlife, the distinction is not always crucial. The effect of a spotlight on a possum may be similar whether it is from a tour guide with a group of international tourists, an ecology student conducting research or a local family having a walk after a barbecue. Hence, although the primary effort lay in searching for literature on wildlife tourism, many of the papers reviewed deal with both tourism and

even non-tourism activities (such as rowing and walking) which could form part of a wildlife tour.

2.2 Interviews

A semi-structured telephone interview was used to obtain information from key staff from conservation agencies on negative effects of wildlife tourism on wildlife in Australia, and on associated management practices (Table 1; interviewees are listed in Appendix A). Staff members were interviewed from conservation agencies of most States and Territories. In each case, a senior member of the relevant section was asked to propose the most suitable person to respond to these questions. In total seven staff members were interviewed, representing six States and territories. Very little prompting was done apart from rephrasing of the questions if their intent was not immediately obvious.

Table 1: Questions asked of key informants from government conservation agencies

1.	Are there any types of wildlife tourism activities you consider of particular concern in terms of negative impacts on wildlife?
2.	Are there any types of animal you consider of particular concern in relation to negative impacts of wildlife tourism?
3.	What legislation and policies does your organisation have relating to managing impacts of nature-based tourism and wildlife tourism on wildlife?
4.	What is your agency's policy on wildlife feeding?
5.	To what extent are numbers of operators/tourists in protected areas limited by a permit system?
6.	What guidelines have you produced to assist sustainable wildlife tourism?
7.	Other than the above, what is your agency doing to monitor, assess and manage impacts of nature-based tourism and wildlife tourism on wildlife?
8.	How effective do you consider these management measures to be?
9.	Are there particular aspects of desired management that are difficult to implement effectively and why?
10.	What research would be most useful to your organisation in effectively managing wildlife tourism?
11.	What do you see as the main obstacles to ecological sustainability of current or future wildlife tourism on free-ranging wildlife?
12.	What is your opinion on the net conservation effects of wildlife tourism on wildlife and the natural environment, considering both the potentially negative effects and the potentially positive effects?

Answers to questions about perceptions regarding perceived negative effects (q1, 2, and 12) are listed in section 3.1.2. Answers relating to descriptions of management and monitoring (q3, 4, 5, 6, 7) were far from comprehensive in coverage (given the difficulty of covering such issues in a short interview) and are integrated into sections 4.2 and 4.3. Opinions expressed in answer to question 10 are presented in section 4.6, and those related to questions 8, 9 and 11 are listed in section 4.7.

3. NEGATIVE EFFECTS OF WILDLIFE TOURISM AND RELATED HUMAN ACTIVITIES ON WILDLIFE

3.1 Introduction

For effective management, it is not sufficient to be aware that negative effects can occur: we need knowledge of the actual causes and effects so that we know where to focus management efforts. Bowles (1995) for instance refers to an incident where 50,000 nests of sooty terns failed, and it was suggested that the failure was caused by sonic booms, without (in her opinion) sufficient evidence. She states that this incident has led managers to give undue attention to the effects of sonic booms when in fact boats, low-flying aircraft and walking humans are more likely to cause reproductive failures. There are likely to be many other examples of jumping to conclusions without adequate investigation of possible causes of problems and their relative importance. Research and compilation of existing knowledge is needed to ensure that we have a reasonable chance of accuracy in our interpretations of existing situations and predictions of possible future ones. In this section we critically review what is known about the negative effects of wildlife tourism on wildlife. We preface this by presenting information on perceptions of Australian conservation managers about these effects, and introduce the classification scheme used for this review.

It is important to caution that one cannot draw conclusions about the incidence of negative effects in wildlife tourism based on this review, since it focuses mainly on the published literature, very little of which reports cases where no negative effects were found. It seems likely that there is a bias towards study of, and publication of, cases where negative effects occur. Thus, for example, monitoring of sea turtles at Mon Repos turtle rookery indicates that wildlife tourism has not had a detrimental effect on the population there (C. Gatley, pers. comm.), but this work has not been published.

3.1.1 Perceptions of conservation managers on negative effects of wildlife tourism in Australia

When the conservation agency informants were asked whether they believed that wildlife tourism in Australia has a positive or a negative effect on wildlife on balance (question 12), all thought the overall effect was positive or potentially so. All considered the potential for education about wildlife (including awareness of the very existence of some species) to be the most positive aspect. This was the same conclusion as reached in interviews focused on positive effects of wildlife tourism by Higginbottom *et al*. (2001b), and indicates that the responses were not influenced in this regard by the focus of the interview. Comments offered on this question were:

- The big positive is the education of voters. Negatives are controllable

- So many people are now seeing whales, and supporting conservation, because we have 'sacrificial' visitor sites at the fringe of natural areas

- If carefully managed (if ecotourism principles are adhered to, interpretation involved and a conservation message delivered), the positives should outweigh the negatives

- If applied correctly, it can change people's views and enhance their appreciation

- There is a small negative effect on individual animals and small populations, but our biggest risk is people losing contact with wildlife, and so – overall – wildlife tourism has a positive effect

- There is an inherent difficulty with wildlife tourism in that it generally deals with charismatic large fauna when invertebrate or other fauna may in fact be more crucial to the healthy functioning of that ecosystem

One conservation agency informant wanted to stress early in the interview (when being questioned about negative effects of wildlife tourism) that the overall positive effect of wildlife tourism outweighs

the negative, and that other activities, such as agriculture, had far more devastating effects than wildlife tourism. He also felt that picnics by local families were probably more damaging than organised tours, as there was less control over the activities of casual picnickers than tour organisers who have to apply for licenses and comply with regulations in order to keep them.

When conservation agency informants were asked if any particular types of wildlife tourism activities were of particular concern, nine different issues were raised (Table 2). Hand-feeding, road/boat kills, spotlighting and disturbance by human travel (walking, swimming, boating etc.) appear to be prominent areas of concern.

Table 2: Wildlife tourism activities identified as potential or actual problems for wildlife by conservation agency informants

PROBLEM	NUMBER OF INTERVIEWEES	DETAILS (NUMBER OF INTERVIEWEES GIVEN IN PARENTHESES IF MORE THAN ONE)
hand-feeding	6	see section 3.4 for details
disturbance of wildlife activity	4	not known if swimming with seals affects the animals, luring of whale-sharks for tourists may affect seals, possible impact of opening-up of recently-discovered nests of waders and waterbirds for tourism in remote areas, separation of mother kangaroos and joeys when visitors approach too closely
road-kills, boat accidents	3	dugongs & other marine mammals (2), general road accidents (interviewee emphasised that roadkills are not just tourism-related)
spotlighting	3	potential problem (penguins and macropods specifically mentioned by one interviewee), regulations are difficult to police at night, degree of impact would depend on frequency
trampling of burrows & eggs (e.g. penguins)	1	minor in comparison with farmers, tractors & cattle that may have trampled for years 'then tourists come along and get all the blame thrown at them'
spread of weeds by horse and camel tours	1	
bird-watchers and photographers may draw attention of predators to nests	1	possible problem, drawing predators' attention to nests or keeping parents away from young, but not particularly serious
handling of wildlife	1	koala-cuddling is featured in one national park but is not an appropriate activity in a national park
artificial lights	1	disorientation of turtles (both of mothers coming onto the beach to lay, and of young finding their way to water)
flash photography	1	
close approach to potentially dangerous animals	1	may lead to relocation or culling of animals that respond with aggression

When asked what animals might be of special concern (question 2), conservation agency informants identified a range of groups of mammals and birds (Table 3). These responses cover only those species that came to the informants' minds during the interviews, and it should be noted that the limited number of species mentioned does not mean we can be complacent about the rest. We should recall that: (a) there is little research to date on the effects of tourism activities on Australian wildlife; (b) it is difficult to observe the effects of activities on cryptic species; and (c) as one informant pointed out, there is often insufficient infrastructure for rangers, who are in a position to see the day-to-day events in protected areas, to report on these to central management.

Table 3: Animals identified by conservation agency informants as being of special concern with respect to effects of wildlife tourism

ANIMALS OF CONCERN	NUMBER OF INTERVIEWEES	FURTHER COMMENTS BY INTERVIEWEES
Marine mammals	3	specifically mentioned: southern right whales, bottle-nosed dolphins, common dolphins
Small mammals hand-fed with inappropriate foods	2	wrong food could upset digestive systems; bettongs specifically mentioned by one respondent, other more general
Turtles	1	at Mon Repos
Seabirds	1	
Cassowaries	1	
Numbats	1	stop activities every time cars go by
Eastern grey kangaroos	1	
Glossy black cockatoos	1	
Eastern rosella	1	
Hooded plovers	1	
Nesting birds in general	1	
Orange-bellied parrot	1	being fed sugar-water – possible problems of disease, parasites and dependency
Honeyeaters and other nectarivores	1	being fed sugar-water – as above
Animals that are normally solitary being encouraged to congregate more closely	1	hand-feeding in particular can cause un-natural crowding, and lead to undue aggression and stress

3.1.2 Categorising negative effects

There are many possible ways of grouping negative effects on wildlife. Those which involve the response of the animal (habituation, avoidance, etc.) are problematical, as such responses – while undoubtedly important – are not always clear, and animals in any one study may respond in several different (or unknown) ways. It seems less ambiguous for present purposes to group information according to the kind of disturbance, using Hulsman's (*in review*) recent

definition of disturbance as a process rather than an effect: ' a process by which a causal agent changes one or more habitat characteristics and as a result changes an individual's chances of survival and reproduction'. The three categories used in this report are:

- disruption of animal's activity (Section 3.2),
- intentional or accidental killing or injuring of animal (Section 3.3),
- habitat alteration (Section 3.4).

These cover most of the possible negative effects on wildlife, and correspond approximately to the three levels of disturbance that are widely quoted from Liddle (1997): 'interruption of tranquillity' (animals seeing, hearing, smelling humans but no direct contact), 'interference with rights or property' (habitat clearance etc.) and 'molestation' (hunting, fishing and collisions with vehicles etc.). We differ slightly by including accidental or intentional feeding of animals as part of habitat alteration, and in not pre-judging levels of severity between the three categories. Habitat clearance for instance probably causes the death of many more animals than well-managed hunting, and disruption of activity of parent animals frequently causes the death of their deserted offspring.

3.2 Disruption Of Activity

Tourists are often unaware that disturbance of wildlife could be a problem, as was the travel journalist who relished a boat-ride in a wilderness area of Northern Territory in 1999: '…through forests of waterlilies and reed beds as birds burst into the air all around us. Those outrun by the boat dive beneath the surface. Occasionally we spot crocodiles, which quickly slide into the water at our approach… '. Does it really matter if wild animals are sent running (or bounding, swimming or flying)? Will they not soon return to their former activities once tourists have moved on? The answer varies enormously between species, life-cycle stages, habitats and other factors.

Animals may respond in a variety of ways to the presence of humans. Some may flee at the first sight, smell or sound of humans, and travel a kilometre or two before stopping. Some may flee to the nearest

cover, or just enough to put a few extra metres between them and the humans before resuming their original activity. Some may simply stay where they are but keep an eye on the humans in case they come closer (and if we have the right equipment we may be able to detect an increase in heart rate or some other physiological change). Others appear to take no notice at all (although this can be deceptive), while others may approach the humans, either to beg for food, to threaten, or out of curiosity.

Such responses may conveniently be summarised as:

- avoidance behaviour (fleeing, hiding, 'playing dead' or aggression in defence of self or offspring);

- habituation (a word often misused, but herein describing a learned lack of response to humans to the point of seeming to ignore their presence); and

- attraction (usually for food or shelter, sometimes accompanied by aggression if not promptly satisfied).

Disturbed animals may show an 'active defence' (or 'fight or flight') response: increased heart rate and respiration, increased blood flow to skeletal muscle, increased body temperature, elevation of blood sugar, and reduced blood flow to the skin and digestive organs. More rarely, they may show a 'passive defense' response ('playing dead'): inhibition of activity, decreased blood flow to skeletal muscles, reduced blood flow to the digestive system, reduced heart and respiratory rate, and a reduction of body temperature (Gabrielsen and Smith 1995). Some animals, such as American woodchucks, may first show an active defense response and then switch to passive when they reach shelter. Gabrielsen and Smith cite various species (mostly American) displaying the passive response: six fish, three reptiles, seven birds species and 15 mammals (including rodents and American marsupials). Little appears to be known about this response in Australian animals, although one of us (R.G.) has witnessed such a response in bearded dragons, which sometimes offer no resistance to being picked up and appear unconscious, but when placed back on the ground suddenly run vigorously for cover.

A certain degree of stress may not harm the animal in any important way, and some species are more vulnerable to stress than others. Referring to welfare of captive animals, Tudge (1992) states that '[t]he obvious problem is to translate hormone level into state of mind ... stresses are not necessarily unpleasant: excitement is stress of a kind, which it could be counter-productive to reduce.' It could perhaps even be argued that animals that have lost their original predators might benefit from occasional mild arousal, but we have little evidence of this as yet. Indeed we have much yet to learn regarding the tolerable stress levels of Australian animals. However, if it is shown that animals are frequently being affected by the presence of humans sufficiently to stay away from favoured breeding grounds, to abandon their young, or come into closer contact with their enemies, it seems reasonable to conclude that management changes are needed. If animals are in a situation from which they are not easily able to move, or have strong reasons to resist moving when approached by humans, the possibility of high stress levels should be taken seriously. Such situations could arise, for example for birds guarding eggs or turtles in the process of laying eggs. Harris and Leiper (1995) cite anecdotal reports of augmented stress levels (increases in aggressive acts, failure to breed on tourist beach) in sea-lions at Seal Bay, Kangaroo Island, before the current systems for regulation of visitor access to the breeding colony.

Highly-stressed animals that are relatively unimportant in a conservation sense (e.g. common brushtail possums in Australia), still represent a problem in animal welfare. Hand-fed possums in at least one Australian campground have developed ulcers, hair-loss and other disorders which were judged by staff of the Currumbin Sanctuary Veterinary Hospital to be the result of stress resulting from over-population (K. Reid, pers. comm.).

3.2.1 Some general factors influencing the disruption of animal activity by humans

Factors that may determine the extent to which an animal is likely to be affected by human activities include:

- The company of other animals of the same species: Gutzwiller *et al*. (1998) found birds in small flocks to be disturbed more easily than those in large flocks.

- Height at which animals spend their time: Gutzwiller *et al*. (1998) found that birds which are active close to the ground have less tolerance of human activity than birds which spend more of their time higher in the trees.

- Conspicuousness: Gutzwiller *et al*. (1998) found that the conspicuous birds had less tolerance of human activity than more camouflaged species.

- Size of animal: smaller birds such as blue tits were found by Cooke (1980), to be more tolerant of human approach than larger birds such as rooks. Knight and Cole (1995) state that 'Comparison studies indicate that larger species flush at greater distances than smaller species' (Cooke 1980, Skagen *et al*. 1991, Holmes *et al*. 1993). Presently there are two explanations for this pattern: (1) because of greater human persecution, larger, more conspicuous species have increased reason to be wary (Cooke 1980); (2) these variations in flushing are due to differing energetics of size (Holmes *et al*. 1993) According to Knight and Cole (1995) 'Small species are consequently more energetically stressed if they are repeatedly forced to take flight.'

- Previous contact with humans: Cooke (1980), Swenson (1979), Poole (1981) and others have found birds to be more approachable in areas of high human usage than in areas where human contact is less frequent or where birds have been persecuted (e.g. crows chased or shot at by farmers versus crows in suburban areas). Emma Gyuris (pers. comm.) found that colonially-nesting sea-birds in north Queensland that were disturbed relatively frequently appeared to be more tolerant (judging from behaviour and chick growth) than birds that were disturbed less often: she hypothesises that this is because the birds habituate when exposed to frequent human presence that is essentially non-damaging.

- Means of transport: animals are often more likely to show more dramatic physiological defence when approached by walking humans rather than by vehicles (Gabrielsen and Smith 1995). Military manoeuvres in Norway were more disturbing to moose when on foot than in vehicles (Andersen *et al*. 1996). Numbats are less disturbed by approaching vehicles than by footsteps (D. Moncrieff, pers. comm.). Disturbance of wildlife by tourists on foot safaris is a problem in parts of Kenya (Sindiyo and Pertet 1984).

- Openness of habitat in which animals are seen (Gabrielsen and Smith 1995): Van der Zande *et al*. (1984) found significant negative correlations between bird densities and recreation intensities for eight of 13 species, with a stronger recreation effect in deciduous than conifer plantations, probably because of lower visibility in conifer foliage.

- Openness of habitat in which the animal usually lives: Burger *et al*. (1995) suggest for instance a difference between edge species and deep-forest species.

- Predictability of human activity: shore angling may have greater impact on waterfowl than other land-based activities such as bird-watching, walking, picnicking, as anglers have long periods of relative inactivity interspersed with short periods of rapid movements. Geist (1978), Geist *et al*. (1985) and Gabrielsen and Smith (1995) refer to the disturbing effect of changes in routine of humans, e.g. when walkers move off the usual trails (Bell and Austin 1985).

There are certain critical times when disturbance of activity may be particularly damaging, especially if the disturbing events occur frequently:

- Foraging: animals may be deterred from feeding, from catching prey, or from using optimal feeding areas.

- Nesting and caring for young: animals may fail to nest in optimal habitat, spend less time defending eggs or young, spend less time insulating eggs and young from extreme temperatures,

spend less time feeding young, or desert the nest altogether (Gabrielsen and Smith 1995, Giese 1996).

- Resting: animals leave shelter and face predators usually avoided by daily activity patterns, or use up energy resources they should be storing for migration or foraging activities, e.g. penguins and seals which expend a lot of energy fishing in cold waters.

3.2.2 The effects of human-induced light and sound

Spotlighting is often seen as a harmless activity, but it is obvious from the behaviour of many nocturnal species that spotlights disturb them. Owls frequently stare into the light and then turn their faces sideways and downwards, possums curtail their social or foraging activities, gliders will sometimes glide away from a food tree and even the rather slothful koala will often move to higher branches (pers. obs.). This use of spotlights is considered to affect the night vision ability of the wildlife being viewed (Lindenmayer and Press 1989). Studies in Victoria claim that repeated spotlighting activities have delayed the emergence time of greater gliders and yellow-bellied gliders (*ibid*). It is speculated that spotlighting activities may result in increased predation and injury risk, reduced foraging ability, reduction in the density of individuals, variations in nesting and parental care and decreased reproductive success (Wilson 1999). The consequences of temporary vision loss are potentially serious for flying and gliding animals (including diurnal birds inadvertently woken by the lights) which need to see obstacles and landing sites. Daryl Moncrieff (pers. comm.) has seen a yellow-bellied glider, when startled by a spotlight beam, change direction and thus lose momentum and fall to the forest floor, then scramble up an Acacia sapling amongst dense vegetation, from which it would be difficult to glide.

Wilson (1999) has conducted one of the few studies to date on impacts of spotlighting on wildlife, focussing on rainforest possums in north Queensland. Decline in numbers of possums sighted has been reported in some regions, but Wilson notes that we do not as yet know whether this reflects a local drop in numbers or an avoidance of the lights by hiding from observers or shifting away from regular spotlighting sites. Wilson captured and fitted radio collars onto three ringtail possum species. First, using infra-red and low-intensity light

(10-watt), she observed possum behaviour without spotlighting. She then conducted observations using a 30-watt spotlight with and without a semi-opaque filter, which lowered the light intensity by about one quarter. She reports that under the less intense light, the possums made 'fewer agitated movements', and could be watched for longer periods before they moved on. Almost twice as many were seen using the less intense light, suggesting that possums were turning or moving away from the bright light. Red, green and semi-opaque filters used on a 30-watt lamp (all reducing light to similar degree): the lowering of intensity decreased the intensity of possum response but colour did not seem to matter. Experiments with frequent spotlighting induced possums to move further from the road and higher into the trees without actually leaving the area. It is speculated by Wilson (1999) that the temporary loss of vision resulting from spotlighting may last for up to half an hour after the light source is removed.

Further investigation of this kind is needed even for possums, but even more so for other nocturnal mammals, birds and other animals (e.g. geckos, frogs, spiders, freshwater crustaceans and moths: all of which can be detected by eye reflectance at night).

Although not conducting scientific research into the effects of spotlighting, Ray Ashton, former program director for International Expeditions (pers. comm.), has many years' experience of spotlighting in Australia and other continents. He 'found that mammals behave in nearly the same manner be they leopards, kangaroos or skunks. If the span of interruption is more than 72 hours, there appears to be no change. If it is less, they simply shift home ranges and avoid the area where they were harassed. The noise and confusion with tourists around them may have the same effect as the light since diurnal disturbance with tourists causes the same result.'

Many tourism operators now use red filters (as recommended by NEAP) to lessen the intensity of light once an animal is located, and at least one (Alberto Vale of Wildscapes Safaris) also uses red filters on the headlights of the tour vehicle in a section of road with locked gates (this would obviously not be safe on public roads). Another, very simple method of reducing glare is to view animals in the periphery of the light beam rather than the central full beam. Lower light

intensities may have a bonus of enhancing visitor experience, providing not only a better view of the animal while it is engaged in its usual activities, but also a better feeling of what night-time in a forest is really like. Guides can also attempt to find some animals by turning off lights and listening for rustles, which also gives the tourists the opportunity to experience the bushland under natural starlight or moonlight, a mood many will otherwise remain unfamiliar with. Nightscopes or infra-red binoculars are also useful but expensive.

Many tourist resorts and associated complexes in natural areas are well-lit at night for the safety and pleasure of their guests, but there is much we do not know about their effects. Female turtles are known to be inhibited from coming ashore for nesting by bright lights, and their young can be disoriented when dispersing to the sea: this problem is nowadays carefully-controlled at the nesting sites most frequented by tourists. At Australia's largest tourist attraction based on nesting sea turtles, Mon Repos Turtle Rookery, the use of lighting is carefully controlled. Low-pressure sodium vapour lights are used, and the light is directed downwards (as opposed to regular lights that create a false horizon that may disorientate the turtles) (QPWS 1996). Individual birds (including honeyeaters and kookaburras) have been known to alter their daily activity patterns and catch insects through the night (pers. obs.). More worrying is the possibility that migratory birds, many of which fly at night to avoid aerial predation, could become confused and fail to reach their destination or appropriate resting spots along the way. Beier (1995) recorded that mountain lions (*Felis concolor*) avoided artificial lights when moving through the San Ana Mountains of California.

Human-induced noise may promote several kinds of problems (several of which are reviewed by Bowles 1995):

- Wildlife can be startled from foraging, breeding, resting or other behaviour.

- Constant noise may detract from an animal's ability to find its prey (including the detection of soft sounds such as insects rustling amongst foliage or leaf litter) or to avoid becoming prey to another species.

- A sound that repeatedly startles an animal may, by increasing its level of activity, cause it to deplete energetic reserves.

- Repeated noise of sufficient volume could damage an animal's hearing ability (this could potentially occur during a prolonged construction phase of major tourist facilities, or during frequent high-volume night-time entertainment at eco-lodges).

- Some noises can give confusing signals to an animal or mask other noises of importance (such as mating or territorial calls).

It may not be always obvious to our human ears that a problem exists. Young (1962) notes that 'birds are … more sensitive to low frequency vibrations, such as distant gunfire, than are humans.' Wild animals often respond to sounds – such as quiet human voices – that would go effectively unnoticed by humans or laboratory animals which have not learned to associate such noises with stressful events (Bowles 1995). Anderson (1995) thus cautions that even when shooting does not directly cause a significant decrease in population numbers, it has the potential to disturb animals (both target species and others) within hearing range and cause them to leave the area, and can also sensitise animals to the presence of humans, making them more wary. Underwater noise is not obvious to most humans but can seriously affect underwater species. Whales, including humpbacks, become silent during noise of certain frequencies (Bowles 1995). Evans (1996) points out that 'only in the last hundred years have our oceans and rivers been disturbed in any substantial way with additional sounds created by mankind.' The effects on whales and other marine animals of sounds emitted by power-boats carrying wildlife tourists should be considered a potential problem.

Some species habituate quite readily to noise, as evidenced by birds that defy attempts to consistently deter them from orchards or grain-crops. Others tend not to adjust. An animal's degree of sensitivity to sound would presumably be one of the factors affecting its reaction to it. Bowles (1995) notes that nocturnal mammals have the most sensitive hearing among terrestrial vertebrates: she is referring largely to Order Carnivora, but it is possible that carnivorous marsupials such as quolls and Tasmanian devils would also have acute hearing. Nocturnal hunting birds frequently find their prey by sound, and so

are especially likely to be stressed by continual noise. Snakes and turtles have poorly developed hearing, lizards somewhat better. Reptiles are sensitive to vibrations, which are important for detecting prey or predators, and low-frequency noise can induce vibrations within both their substrate and their bodies. Frogs have variable hearing but are acutely sensitive to vibrations. Bowles recommends that the faintest sound an animal can hear is a good prediction of its susceptibility to hearing loss.

As well as making it difficult to hear predators and prey, noise can interfere with social life. 'Masking occurs when noise interferes with the perception of a sound of interest' (Bowles 1995). It happens when 'the energy of a signal and of a noise within a critical band are equal'. Bowles also notes that busy highways may affect the effective range of birds that sing softly. The birds can control this to some extent by where they choose to sing, and there is as yet no evidence of serious consequences.

Wilson (1999) conducted experiments on the effects of sounds on possums, using the kinds of sounds likely to accompany spotlighting activities. The possums appeared to be most disturbed by the scrunching of gravel and, to a lesser extent, snapping of twigs. Adult speaking voices and passing cars were generally ignored (this may not hold in other situations where possums have had negative interactions with humans), but a parked car with its engine running or the clicking of cameras put them on alert or induced them to turn away from the noise. Owens (1977) remarks that 'noisy motorboats induce flight in waterfowl at ranges of 1-2km, but quieter vessels do not stimulate flight outside 500 m.'

Some specific sounds may deceive an animal, prompting it into inappropriate behaviour. The noise of an all-terrain-vehicle was simulated under laboratory conditions to test the reactions of aestivating spade-foot toads, which emerge in response to thunder and rain, a sign that conditions are right for emerging from their burrows for breeding and feeding (Brattstrom and Bondello 1983). The simulated ATV noise prompted the toads to emerge repeatedly. Emerging in dry conditions could cause toads to progressively lose water, and they would expose themselves more to predators. It is likely that many native species of the Australian Outback, which has

the most unpredictable rainfall in the world, would similarly emerge when rainfall is detected. It is possible that ATV's would have a similar effect in Australia: however this remains to be tested.

3.2.3 Disruption of foraging

One of an animal's most basic needs is food. Anything that seriously reduces its ability to take in sufficient quantities of essential nutrients could affect its health or that of its young. If many animals are affected on a regular basis, the population may ultimately decline.

Sometimes the disruption of feeding behaviour is direct. Sindiyo and Pertet (1984) report that in Kenya lions and are often prevented from making a kill through tourist interference. More often the effect is less obvious: a mob of kangaroos flee from a grassy hillside, a flock of water birds will shift to the far side of a lake, or a sugar glider will glide away from the blossom-laden tree in which it was first observed. An occasional disruption of foraging activity may be unimportant, but animals that are continually displaced from favoured foraging sites may not be able to keep up the energy or nutrient levels they need for survival, for migration or for breeding.

Knight *et al*. (1991) experimentally set out a standard number of fish carcasses to attract scavenging birds, and made observations with and without the presence of anglers. Bald eagles and ravens spent more time on the ground scavenging when anglers were absent, although crows did not show the same tendency. White-headed woodpeckers in Yosemite Valley were 'only seen to forage in the heavily populated campgrounds between dawn and 7.00 a.m. when the campers became active' (Garton *et al*. 1977). According to Roe *et al*. (1997), vehicles at Masai Mara National Park usually approach to within 17m of cheetahs and stay an average of 18 minutes, sometimes causing the animal to flee or disrupting their hunting or subsequent feeding on a kill. They report a 30% decline in the cheetah population in the area over four years, an unidentified stress-related disease similar to HIV, and a change in diurnal activity patterns such that hunting occurred in the heat of the day when tourists were absent.

Waterbirds which are visible on the water during daylight hours are frequently in process of feeding, so anything which drives them to

cover or to another body of water is probably having a negative effect on their intake of food. Pierce *et al*. (1993) studied the effect of approaches by small boats on bitterns, cotton teal, egrets, little grebes, moorhens, purple gallinules, stilts and tree ducks in Southern Thailand (the same or related species are also found in Australia). Flight distances were generally greater in open water than in reed beds or amongst other vegetation. Teals, egrets, grebes and tree ducks were generally the most prone to flee, although this varied with season and habitat. Birds generally allowed a closer approach by an experimentally poled boat than when motorised. Fishing (by humans) mostly peaked around dawn and dusk, thus coinciding with the most active feeding periods of the birds. The authors comment: 'the long-term effects of disturbance on bird populations depend on the extent to which feeding is disrupted.' Clearly the availability of undisturbed refuge areas may be important.

We do not always know when an animal is disturbed, because very often we are not aware of the presence of shy animals that have hidden at our approach. Numbats for instance will cease foraging and other activities and take cover at the approach of human footsteps (D. Moncrieff, pers. comm): no effect is noticed by the walker, as the animal has already hidden itself in a hollow log before he or she arrives. Likewise, shy birds, lizards and small nocturnal creatures may well cease foraging and take shelter every time a trail is walked, but without research targeting this, such disturbance will remain unknown.

3.2.4 Disturbance of parental behaviour

Disruption of parental behaviour may compromise that most important function of parental care: survival of the young. Safina and Burger (1983) experimentally varied levels of human disturbance to a bird colony, and found fledgling success to be inversely related to the amount of disturbance. Anderson (1988) found that the reproductive success of pelicans was related inversely to human activity, whether this involved fishermen, tourists and other recreationists, or investigators. Giese (1996) found that researchers counting eggs (including moving penguins gently with pole where necessary) and tourist activity (quiet talking, walking and photography amongst the colony) both depressed breeding success in Adelie penguins in the

Australia Antarctic. This study is the only one we are aware of in Australia that uses an experimental approach to determining effects of wildlife tourism on wildlife. Anderson (1995) notes that most waterfowl form close cohesive groups, and that when family units are broken up through separation or death of a parent, 'the whole family can suffer and the young may perish.' Hermann's gulls (Anderson and Keith 1980) are strongly territorial, but intruders walking through the colony 'create massive confusion' and displacement of adults and young, resulting in predation of eggs and young by neighbouring gulls. Jacobson and Figueroa-Lopez (1994) showed that the presence and behaviour of tourists on the beach during the green turtle nesting season caused disturbance of nesting turtles. 'Tourist visits were concentrated at weekends, correlating with the times that a third fewer turtles came to the beach.' Edington and Edington (1990) report that tourist vehicles sometimes separate young deer and antelope from mothers and they speculate that this may increase juvenile mortality.

An obvious sign of trouble is nest desertion, which is frequently followed by predation on eggs or young. Most research to date has involved marine or aquatic birds. Reichholf (1976) reported a 90% decrease in breeding on waterways in Germany over ten years of recreational use: he noted that one lone angler could prevent ducks breeding on water bodies of less than one hectare, and that waves created by motor boats tipped over exposed nests. Motorised boating (but not canoe travelling) in Minnesota has caused loons to desert their nests (Titus and van Druff 1981) and Wisconsin lakes that are heavily used for recreation were found to be unused by ducks for breeding (Jahn and Hunt 1964). Gutzwiller (1995) found predation of pelican chicks by gulls to increase substantially in the presence of recreationists. Datta and Pal (1993) observed that although open-bill storks became alert when humans appeared they quickly resumed normal life but very noisy activities or bursting of vehicle tyres prompted them to flee their nests, allowing crows to immediately attack the clutch. Great crested grebes (which occur also in Australia) allowed a row boat to approach within 20 m from their nests in a frequently-disturbed European site significantly more often than grebes at an undisturbed site, implying that they have the ability to habituate (Keller 1989). Grebes flying at shorter intervals, however, were less likely to cover their eggs before leaving the nest, and

breeding success was still lower in the disturbed areas. Fisher *et al*. (1998) found a significant negative correlation between the numbers of pied oystercatchers and red-capped plovers and the level of human activity (vehicle use and camping) on Fraser Island, Queensland. They speculated that disturbance to nesting birds is probably more important than factors such as direct hits or impact on their prey.

Desertion of nests by birds of prey has been studied by some researchers. Ames and Mersereau (1964) studied the decline of ospreys (which occur also in Australia) in Connecticut, USA, and concluded that in 1960 at least two nests were deserted because 'picnickers repeatedly kept the birds from incubating.' They also recorded that speeding motor boats caused birds to flee their nests directly instead of first standing up, and in the process, break eggs with their feet or roll them out of the nest. Fraser *et al*. (1985) observed that repeated visits of observers prompted bald eagles to fly from their nests at progressively increasing distances. Huxley (1994) reports that golden eagles and divers leave their nests even when 'a walker, perhaps unaware of the vicinity of the birds' is still some distance away, exposing eggs to sometimes chilling temperatures.

Wildlife species other than birds have not received as much attention in the literature. Harbour seals have abandoned newborn pups after panics induced by various kinds of aircraft within 150 m (Johnson 1977). Kangaroos and wallabies with young in their pouches are often the most alert and observant members of a mob when tourists are viewing them (pers. obs.). Usually they will bound away from perceived danger with joeys still on board, but under extreme stress they are known to eject them from the pouch and escape without them. Sometimes they fail to reunite (Stuart-Dick 1987), which would lead to death of young. American alligators and Nile crocodiles have been known to desert their eggs when tourist boats approach too closely, often resulting in the loss of eggs to predators (Cott 1969, Dietz and Hines 1980).

Disruption of parental activity can deplete the energy reserves of both parent and young. Gabrielsen and Smith (1995) report that female eider ducks do not eat for 25 days during incubation; during this time they lose 40% of their body weight. By seldom leaving the nest, and by using as little energy as possible, the eiders lose only 20 to 25

grams of body weight per day. Disturbance by humans, and repeated reheating of eggs on their return to the nest, results in further loss of essential energy reserves needed later to raise their young. Knight and Temple (1986a, 1986b) report that several American passerine species whose nests were repeatedly visited by researchers became much more aggressive over time: this would take up energy supplies that may not be trivial in critical times.

A shift to sub-optimal habitat in response to human disturbance may cause a decline in survival. Changes of nest-height can result in: ground-foraging parents expending more energy with each flight to the nest to feed chicks; more open canopy exposing chicks and parents to greater wind and temperature fluctuations; or greater exposure to aerial predators (including currawongs and crows). Switching to a different species of tree may entail nesting on structures, which are less secure or nesting in trees offering less protection against predators or extreme weather. Datta and Pal (1993) observed that after nesting failure due to human disturbance, open-billed storks in India re-nested at a significantly higher level and in different tree species. Knight and Fitzner (1985) found that black-billed magpies (American) placed their nests in less accessible sites each year after humans had climbed to their nests, and that when constrained by nesting substrate, the number of nesting birds declined. Nesting records from the 1930's onwards for royal albatrosses at the only albatross colony on mainland New Zealand revealed that the nesting distribution has gradually shifted away from human presence despite the tendency of these birds to be extremely conservative in their nest site selection (Higham 1998). This has resulted in a move to sub-optimal nesting areas, and fledging of chicks before sufficient development of wing muscles.

Disturbance at certain critical periods may be more likely to cause serious negative impacts. A study of golden plovers by Yalden and Yalden (1990) began with the assumption that incubation would be a very sensitive time for these birds, which were often disturbed from their nests by hikers. However, they tolerated approaches to within 10 m while incubating, but did not generally tolerate approaches closer than 200 m when they were with their chicks after hatching. Bunnell *et al*. (1981) reports that 88% of the eggs in a pelican colony were crushed by disturbed adult birds when an aircraft flew over shortly

after laying, but flights during brooding had little impact. Anderson and Keith (1980) report that 'brown pelicans suffered severe setbacks as a result of even one disturbance early in the nesting season.' When adult pelicans were disturbed from their nests by humans, fleeing chicks sometimes impaled themselves on *Opuntia* cactus and died there, and both eggs and chicks were often attacked by western gulls, which sometimes walked ahead of human intruders pecking eggs.

3.2.5 Other examples of disruption of wildlife activity

Wildlife of rainforest undergrowth may avoid people by becoming more nocturnal or arboreal, leaving the area, or avoiding the trails likely to be used by visitors (Griffiths and Van Shaik 1995). Pigs, squirrels and most primates move only short distances and resume activity, but members of the cat family seem to become more nocturnal (*ibid*). Continued intense human activity may have a similar effect as hunting, in that easily-habituated animals may experience less predation than their competitors. Little is known of how Australia's rainforest mammals respond to use of walking tracks.

Chamois in Austria escape to steep, forested cliffs in response to skiing (Hamr 1988). It would be of interest to know whether Australia's rock-wallabies do so in response to hikers and rock-climbers on well-visited mountains, and if so, whether for long enough to disrupt normal activity patterns.

Tourists sometimes view scenery and wildlife from the air. Sindiyo and Pertet (1984) report that in Kenya, elephants 'do not seem to be unduly affected' by balloon safaris but that 'buffalo and in particular lion have never adjusted to these flying objects and constantly dash away into hiding whenever one passes over.' Côté (1996) found mountain goats in Canada to be highly disturbed by helicopters, resulting in movement from the area, splintering of herds, and in one case severe injury. They recommended from their results that helicopters not be allowed within two kilometres of goat populations. They also comment that bighorn sheep have been found by others to be disturbed by aircraft and that musk oxen and moose are less sensitive (though some flight behaviour has also been recorded for these). Bowles (1995) reports that low-altitude aircraft can frighten flocking waterfowl into colliding with power-lines and other human-

made structures, especially (from anecdotal accounts) approaches within 100 m.

Hulbert (1990) studied the effect of tourist canoes on the distribution and daily activity of ruddy shelduck wintering in Nepal, and found that the return journey, when the empty canoes had to be hauled back upstream, was responsible for 74% of the total time disturbed. Mabie *et al*. (1989) found that changes in use of territories by cranes are possible if boat use occurred frequently within family group territories.

Direct contact between human and animal can have negative effects (in addition to hand-feeding as discussed elsewhere). The petting of wildlife is not usually a conservation problem, as they can choose to move away from humans, but becomes the subject of an animal welfare debate in captive situations (Van Tiggelen 1994). Petting attempts may also be a problem with less mobile creatures such as chicks of penguins and other marine birds. Deliberate mistreatment is sometimes a problem, especially where wildlife have learned to be too trusting of humans. Small boys at picnic and camping grounds are sometimes seen pelting stones at birds, frogs or reptiles or attacking them with sticks; and there have been cases on Rottnest Island (Western Australia) where quokkas have been kicked until severely injured or dead. Another possible problem of human contact with non-captive animals is the transmission of disease from human to animal (this is carefully watched in some situations: for instance, no one with a respiratory infection is allowed into the water with the dolphins at Tangalooma Resort, Moreton Island). One of the most serious threats to the persistence of endangered populations of mountain gorillas involved in wildlife tourism appears to be the threat of disease transmission from humans to the apes (Butynski and Kalina 1998). Eight gorillas are already thought to have died through such means since 1988.

We thus know enough from Australian and international experience to be cautious about the effects of tourism activity on the activities of wildlife, especially where they might affect breeding success or energy reserves. Much research remains to be conducted on:

- the sensitivities of Australian animals to relevant kinds of light and sound, and their responses to same;

- critical stages of breeding at which they are most likely to desert young;

- 'safe' distances to which animals (especially breeding individuals) can be approached;

- the effects of human approach on small cryptic species (including for instance small ground-dwelling marsupials and native rodents, and small bush birds whose nests might be unwittingly approached closely while observing other wildlife); and

- the effects of hand-feeding both on the animal and the human (e.g. whether the increased rapport with hand-fed animals leads to an increase in the human's interest in their conservation).

3.3 Direct Killing and Injuring

This section includes the obvious, immediate effects of killing or injuring animals either intentionally (e.g. hunting) or accidentally (e.g. vehicle collisions).

3.3.1 Road accidents and other vehicular injuries and fatalities

Wildlife tourism operators and eco-lodge personnel we have talked to believe that wildlife tourism is responsible for relatively few roadkills in Australia, compared with inattentive driving by locals or long-distance travellers passing through wildlife-inhabited areas, especially at dusk or after dark. However, wildlife tourism does have the potential to increase roadkills by (a) bringing more traffic into a wildlife-rich area; (b) habituating animals to traffic and parked cars and thus making them less wary on roads and in campgrounds; and (c) creating a positive attraction to vehicles by animals learning to associate them with food provision. Roadkills sometimes also involve an unfortunate positive feedback ('vicious circle') in that once an animal has been converted into carrion on the road or roadside, scavengers (including Tasmanian devils and raptors such as wedge-tailed eagles) are secondarily endangered by feeding there.

Although roadkills are unlikely in most cases to detrimentally affect animals at the population of species level, there is evidence than they sometimes do so – even to the point of local extinction – for large species or those that are already threatened (Jones 2000). One Australian study provided good evidence that a whole population of eastern quolls became extinct as a result of deaths associated with upgrading of a road at Cradle Mountain-Lake St Clair National Park (*ibid*). Further, very large numbers of Australian animals are killed by motor vehicles – in Tasmania alone, it is estimated that these deaths number more than 4 million per year (N. Mooney, pers. comm.).

Liddle (1997) identifies roadkills as one of the two major mortality factors for snakes caused by recreation (the other being deliberate killing of snakes around campsites and other populated areas). Manidis Roberts Consultants (1997) consider that a potential cost of road improvement on Kangaroo Island, South Australia, is an increase in speeding and resultant increase in roadkills of animals. Sindiyo and Pertet (1984) report that speeding causes wildlife mortality in Kenya. Many of the tour operators interviewed in a study of macropod tourism (Higginbottom *et al*. 2001c) mentioned the problem of roadkills (though not necessarily by tourists or tour operators). Dead kangaroos are indeed a common sight on many country roads (pers. obs). Rock wallabies on one of the peaks in the Warrumbungle Ranges appeared to constitute a healthy and stable population. After a road was constructed passing below the peak and a walking track to the summit, the wallabies were frequently disturbed by voices and footsteps, and by the early sixties 'the last rock wallaby had gone from this mountain, run over on the road below as it tried to evacuate' Fox (1982).

Roads are not the only places where animals are hit by vehicles. The effects on desert wildlife of an increase in the use of off-road vehicles (ORV) in the American southwest have been a cause for concern (Luckenbach 1978). Impact on habitat by ORV's is referred to in Section 3.4.1, and disruption of activity in Section 3.2, but there is also the risk of direct collisions with wildlife, or the trampling of underground species. Ghost crabs in USA forage at night, and otherwise shelter in burrows, and ORV sites had very low numbers of ghost crabs compared with undisturbed beaches or beaches with pedestrians only (Steiner and Leatherman 1981). ORV's can directly crush crabs, in addition to the possible effect on gill functioning

mentioned in Section 3.4.1. Research into the environmental effects of snowmobiles on wildlife in USA indicates that in general, they have little effect on larger animals; moderate effects were observed on medium-sized animals; and small animals over-wintering in sub-snow environments were drastically affected (Bury 1978).

Boats are capable of serious effects on marine and aquatic fauna. Shackley (1992) reports that the greatest threat to the survival of (at that time) dwindling manatee populations of southern Florida USA is water-based tourism. In 1989, the population experienced an estimated mortality of 10% in 1989, chiefly caused by collisions with boat propellers. A highly successful public education and awareness campaign ironically resulted in increased interest in manatees, with the consequent emergence of new forms of tourism: divers, helicopters and canoeists. According to Shackley, a powerful commercial lobby is emerging which makes the imposition of tougher legislation or the extension of manatee sanctuary areas unlikely, and it seems probable that the manatees are about to become victims of their own publicity. The possibility of boat collisions with dugongs in such places as the Hinchinbrook Channel, Pumicestone Passage and Moreton Bay is thus of concern. Two dolphins at Tin Can Bay, Queensland are hand-fed daily in an area where boats are constantly pulling in and out of shore. This provides a danger of injury to both dolphins and visitors.

3.3.2 Hunting, fishing, and collecting

Tourism activities based on the deliberate killing of wild animals (often referred to as 'consumptive wildlife tourism') are often controversial, particularly in Australia. This is because of potential concerns on one or more of the following grounds:

- ethical and other philosophical issues regarding the morality of killing animals;

- effects on the enjoyment of other wildlife tourists or local residents;

- animal welfare issues regarding the suffering experienced by the animal before death (especially injured animals not immediately found and despatched); and

- ecological/ conservation issues regarding effects on biodiversity (in most cases any effects are expected to be negative, but in some cases they can be positive).

It is important to distinguish between these issues, and our review here is limited to the final two points, which relate to welfare and conservation effects on wildlife or their habitats. It should however be noted that much of the controversy relating to the acceptability of hunting relates to ethical issues (see Bauer and Giles 2001). Some readers may have opinions about the following suggestions from an ethical point of view, but a discussion of ethics is outside the scope of this report.

Negative effects of hunting and fishing from an animal welfare point of view concern the level of suffering (pain and psychological trauma) experienced by target animals. This will depend on factors such as the type of weapon or equipment used, the number of shots taken to kill an animal, the time from impact till death, and how hunters deal with dependent young. The most humane method will depend on the species concerned. The level of suffering that a society considers acceptable often varies between different types of animals (Singer 1990). In part this relates to differences – or at least perceptions of differences – in the ability of different animals to feel pain and distress (Varner 1998, Singer 1990). It also varies according to preferences that people have for different types of animals (see Green *et al*. 2001). In Australia, this is particularly relevant in relation to public acceptance of methods for killing of feral pest species as compared with native species. Higher levels of suffering and generally fewer restrictions are legally allowed for feral species (see Wirth 1998, Singer 1990). Similarly there is less public concern about the animal welfare implications of fishing than hunting, despite the fact that researchers generally agree that fish are capable of feeling pain (Varner 1998). Although fishing normally involves killing (usually through lack of oxygen once out of water), many individuals that do not meet required criteria are returned alive to the water, in the hope that they

will survive. Concerns have been raised about potential suffering in both scenarios.

Conservation issues generally relate to unsustainable rates of exploitation that lead to a decline in animal populations, although they can also include effects on genetic diversity or non-target species. History certainly provides good reason for concern about the impacts of hunting and fishing on abundance of the exploited species. Hunting with insufficient regulation has caused several past extinctions, such as the passenger pigeon of North America, the quagga of southern Africa (Marshall 1988) and the toolache wallaby of South Australia (Strahan 1998). Many other species have suffered severe declines at least partly as a result of hunting, although only in two cases (the Columbian grebe and passenger pigeon) is this thought to have had a significant recreational component (Schorger 1973, Caughley and Gunn 1996). In the case of fishing, most reported cases of over-fishing have involved commercial fishing, but recreational fishing can also be significant threat in some cases (see below).

Changes in population structure are probably a common consequence of hunting, which tends to favour certain types of individuals. A male-bias in shooting (mostly trophy hunting) of brown bears (Ursus arctos) in Slovenia is reported to have changed the population sex structure (Adamic 1997). Prins (1987), discussing trophy hunting in Tanzania, refers to a belief that 'by selectively killing the 'most beautiful' animals, the population will possibly slowly deteriorate. Hence the trophy industry will destroy itself'. Generally however, the effects of such changes on the long-term genetics of populations are poorly understood.

Effects on non-target species obviously occur if such species are accidentally killed, and this can be a particular problem if they have a threatened conservation status. This is a frequently raised concern for Australian waterfowl, although the threat is thought to be much lower than in the past because of efforts to educate hunters in identification (Garnett and Crowley 2000). Deaths of non-target species can also occur indirectly, as has been reported from magpie geese ingesting lead shot (*ibid*). Effects on non-target species may be expected to occur when the target species is a predator, prey or

competitor of one or more other species (which is usually the case). For example in the latter case of trophy hunting, is it better for a hunter to interfere with the social group and population genetics of the target animal by selecting the strong and healthy animals, or risk interfering with the predator populations by competing for the weaker animals they would normally take?

Normally a harvested population will occur at significantly lower abundance than a non-harvested population – in fact, to maximise the number of animals that can be sustainably harvested, it will need to be reduced by about half (for explanation of this see Caughley and Gunn 1996, pp343-345). Not only will this cause a change to the target population that some might consider intrinsically undesirable, but it almost inevitably leads to changes in community dynamics that may affect other species. In the case of recreational fishing in Australia, one of the major ecological concerns is the introduction of exotic species into water systems, with largely unknown effects on the native species.

In cases where hunting and fishing do not have detrimental effects on wildlife populations, this is either because either there is very little demand for these activities or there is an effective regulatory system. Such a system generally requires a good knowledge of population dynamics, ecology and natural behaviour, including seasonal requirements. Lent (1971) for instance advises that the hunting of musk oxen should not occur during rutting as this will impact on the formation and maintenance of social groups. Sensitive times exist for Australian wildlife also, especially involving breeding, caring for young, congregating in relatively resource-rich areas during lean times, and constrictions in travel routes during migration. Regulation is more likely to be effective than for purely commercial harvesting, since in the latter case a number of economic principles are likely to favour the over-exploitation of natural resources (see Caughley and Gunn 1996, pp347-351 for an explanation).

In Australia, hunting by tourists at this stage involves mainly introduced species, most of which are widely considered to be pests, and therefore concerns about negative effects on the target wildlife relate mainly to animal welfare considerations rather than conservation issues. The main native terrestrial vertebrates currently

involved in recreational hunting are waterfowl (mainly ducks), quail, and certain species of kangaroo and wallaby. There seems to be no substantial scientific evidence that these activities have caused declines in abundance of the target species. However, they have led to both animal welfare and conservation concerns among some sectors (e.g. RSPCA 2000). It is possible that with recent growth of interest in commercial use as a conservation tool (e.g. Grigg *et al*. 1995, Senate Rural and Regional Affairs and Transport References Committee 1998, and various national and international policy initiatives) there may be future moves towards recreational hunting of other native species. If this occurs, concerns about the welfare and conservation implications may re-emerge into greater prominence. Further details on the nature of the Australian hunting industry and associated activities are provided by another report in this series by Bauer and Giles (2001).

Fishing is essentially an aquatic form of hunting. In Australia, recreational fishing (including that by tourists) occurs mostly in coastal systems and focuses on native species. Most fishing involves conventional hook and line methods. There is also a growth of catch-and-release fishing, because of concerns in relation to conservation and animal welfare. Although there has been a paucity of systematic research, some evidence points to declines of inshore fish stocks in Australia, as a result of both commercial and recreational fishing (McPhee and Hale 1995). In some areas of high human populations, recreational fishing probably has a greater negative effect on inshore fish stocks than does commercial fishing (*ibid*). In terms of freshwater fishing in Australia, Lake (1976) mentioned only one freshwater fish – the Derwent whitebait (*Lovettia sealii*) – which was then considered to have been over-fished, but also mentioned that 'The tragedy of Australian species is that we do not know enough about the biology of several species'.

Invertebrates are not usually hunted in the same way as vertebrates, although exceptions are crustaceans (e.g. crabs, lobsters) and molluscs (e.g. mussels, oysters). They are however frequently collected by tourists or by those who sell them to tourists. Sindiyo and Pertet (1984) report that 'uncontrolled shell and coral collection [is] contributing to the decay of marine parks on Kenya's coasts' and shell collection is also a problem on the Galapagos Islands (De Groot 1983).

Shells are collected by some tourists on Australian beaches and the Great Barrier Reef, and many are sold in souvenir shops, but to our knowledge there is no comprehensive survey of the effects of this on the reef, shoreline and marine communities. Where dead shells and coral are collected from beaches there may be little damage done (except perhaps where it affects other species such as hermit crabs needing empty mollusc shells). However, souvenir dealers and some amateur collectors prefer mollusc shells that have been collected live as they often have more intense colour and brighter shine. Many casual collectors are unaware of cumulative damage, and some commercial collectors do not have the kind of attitude one would hope for. Lunn (1975) relates an incident where Noel Monkman came across a woman collecting large quantities of volute shells on Heron Island, Queensland (before current protection measures for the Great Barrier Reef). On being told they would become extinct if this level of collection continued she replied 'that's good, that will push the price up.' Collectors have sometimes visited small islands in the Everglades floodplain, Florida, collected all the Everglades snails they can find, and set fire to the vegetation (which is not fire-tolerant) to prevent other collectors from collecting the same species (Daryl Moncrieff, pers. comm.)

New (1991) considers the mass collection of butterflies for tourist souvenir jewellery to be far more damaging than the collection of specimens by researchers and amateur naturalists, and cites Carvalho and Mielke (1971) in recording that over 50 million butterflies are killed for this purpose each year in Brazil. Yen and Butcher (1997) present codes of ethics for collection of butterflies and other terrestrial and aquatic invertebrates, and report that at the time of writing new legislation was being prepared in Northern Territory to require collectors of invertebrate animals for commercial purposes to apply for permits.

3.3.3 Other direct causes of wildlife mortality

Other possible causes of wildlife mortality associated with wildlife tourism include:

- Trampling: Standing on corals during breaks in snorkelling and the anchoring of boats on coral reefs are recognised as problems in Kenya (Sindiyo and Pertet 1984). The same occurs in Australia

(Kay and Liddle 1987), although responsible tour operators inform their guests and attempt to minimise the problem (pers. obs.). Yalden and Yalden (1990) report an incident where, although very aware of the nesting birds and presumably being very careful, researchers trod on two golden plover chicks during research on human impact. Inexperienced tourists could obviously do far greater damage in such colonies. In addition to habitat changes (Section 3.4.1), trampling around campsites and other well-visited areas can doubtlessly kill many invertebrates of soil and leaf litter.

- Killing of wildlife for safety reasons: e.g. proprietors or tourists killing snakes, including harmless ones.

- Insecticides used for tourist comfort: Again, no comprehensive study has been conducted on this, but it seems obvious that insecticides will kill more than the target mosquitoes and other 'nuisance' insects. This may include some of the animals visitors want to see (e.g. butterflies) and those forming part of the food chain for vertebrate wildlife (which may be affected by the toxins in the body tissues of their prey or by a reduction in prey numbers).

- Fire-break burning of forest edges or understorey, especially during spring when many species are breeding and their young are unable to escape.

3.4 Habitat Alteration

3.4.1 Vegetational changes and soil compaction

Wildlife tourism can cause vegetational changes in several ways:

- Total clearing for accommodation, parking, and other infrastructure, for human comfort (e.g. draining of mosquito-harbouring swamps) or other reasons (enhancement of hill-top view): infrastructure which targets wildlife tourism might be expected to keep this to a minimum, but proprietors might be focussing on particular animals (e.g. koalas, kangaroos) and eliminate other habitats not used by these species.

- Partial clearing and fragmenting for cabins, campsites, picnic areas, fire protection, roads etc.: this can increase population numbers of aggressive or predatory 'edge species' (Catterall *et al*. 1991, Green and Catterall 1998) to the detriment of other species; cut through territories or home ranges of some animals and thus eliminate or reduce the numbers of species which need a certain size of continuous habitat; enhance access by feral animals and human visitors; and alter the microclimate at the habitat boundary.

- Habitat modification: while seemingly less drastic, vegetational changes within an area of habitat can lead to the failure of species to survive or breed. It includes change instigated by developers (converting understorey shrubbery to grassland for camping and picnics) and changes through the activities of tourists (trampling, firewood collection). One of the most serious (and common) changes is the removal of large mature trees (possums, gliders, owls, frogmouths, parrots and other wildlife need hollows in these for breeding, and often for daily shelter as well). Another is the removal of understorey (an essential component of forests and woodlands for many small birds, mammals and lizards: even an exotic understorey such as *Lantana* is often better than no shrubby understorey and needs gradual replacement rather than abrupt removal).

If we understand the possible effects of habitat removal or modification for various species that may be dependent on it, we can endeavour to minimise impacts or compensate for inadequacies (e.g. by providing nesting boxes). There will however be situations where such minimisation or compensation will not be effective, and where clearing should generally not be permitted.

If an animal has to move from its home range it may look to human eyes as though little harm is done. However the animal may have a particular reason for being where it was, whether because of better shelter from predators, appropriate nesting sites, less competition with other animals of the same or similar species, or better access to water or food in lean times. It will thus not necessarily survive in the new locality.

Vegetational changes can seriously reduce the insect prey of birds, lizards, frogs and small mammals. Insects on foliage in Melbourne suburbs were found significantly more frequent on native than exotic vegetation, and native insect-gleaning birds in suburban areas fed significantly far more often amongst native than exotic foliage (Green 1984). Grass-hoppers in a recreation area in Natal were very sensitive to the planting of exotic conifers (Samways and Moore 1991). Soil compaction has great impact on soil invertebrates and young seedlings. Vosin (1986) showed that 'even diffuse human trampling' drastically reduced the numbers and diversity of grasshoppers and crickets, even before any vegetation changes were visible. Luckenbach and Bury (1983), showed 'remarkably lower numbers' of nocturnal trails of scarab beetles in areas driven over by off-road vehicles, both from direct crushing and from compaction of the plant matter the beetles live in.

Campgrounds often suffer from soil compactions, trampling, and collection of firewood from trees or fallen logs (which may be sheltering small mammals or lizards). Blakesley and Reese (1988) found seven species positively and seven negatively associated with campgrounds. Five of the seven that were positively associated nest in trees, and all the negatively associated species nest low (ground, shrubs or small trees). Apart from removal of trees by site managers in Yosemite campgrounds, 'campers destroyed 30% of the Stellarís jay (*Cyanocitta stelleri*) nests and 20% of American robin nests by removing branches for firewood and making room for tents' (Garton *et al*. 1977). In the Himalayas, a major cause of deforestation has been the supply of firewood to tourist trekkers (WWF 1995). Soil deterioration on campsites in forests of northern USA included decreases in percentage leaf litter cover, soil macrospore space (important to many invertebrates and plants) and an increase in soil bulk density (Legg and Schneider 1977), all of which can impact soil invertebrates.

Off-road vehicle damage is a concern in many areas. Sindiyo and Pertet (1984) report vegetation damage by off-road vehicles in Kenya, and that increased traffic in general in parks has led to increased off-road driving. Buchanan (1979) comments that 'severe damage is caused by recreational activities in natural areas. The most damage is done by the well publicised trail-bikes and four wheel drive vehicles

resulting in destruction of vegetation, soil erosion and compaction.' Off-road vehicles on sandy beaches can 'mix dry upper sand with moister sand of the burrow zone, possibly causing a drying of the crabs' gills, resulting in mortality' (Steiner and Leatherman 1981). Off-road vehicle damage to desert vegetation and soils is reviewed in Luckenbach (1978).

Vegetation trampling and soil compaction are also caused by human feet. Sindiyo and Pertet (1984) report on 'uncontrolled and haphazard development of trails for wildlife-viewing' in Kenya and resultant damage by visitors on foot safaris, especially in areas of fragile soil. Fox (1982) remarks that walking tracks in the Warrumbungle Ranges 'had been superbly designed and built but in country of such steep slopes zig zags were inevitable. Uncontrolled youth ... shortcutting corners had broken down the drainage system resulting in massive soil and boulder movements.'

At least two experimental studies have examined the effects of horse-riding in Australian natural ecosystems. Recreational horse-riding in an alpine region in Tasmania (Whinam *et al*. 1994) was found to cause vegetational changes due to trampling alone, and several weed species germinated from manure and survived to seed-setting stage. The authors found by grassland to be less vulnerable to trampling than shrubland (they recommend restricting riders to trails in the latter) and that damage to herbfield and bolster heath was of sufficient severity to recommend the banning of all horse-riding within them. Phillips and Newsome (*in review*) have found even low levels of horse use to affect plant species composition, vegetation height and percentage of bare ground in *Eucalyptus*, *Banksia* and *Agonis* woodlands of southwestern Western Australia.

The clearing of native habitat for the construction of roads and buildings has an obvious and immediate local impact: somewhat less obvious is the effect on wildlife which use the area intermittently but perhaps at periods critical to survival, such as during drought or failure of a fruit crop. A problem in some areas of the world is the disruption of migration routes of large mammals (such as wildebeest and other ungulates in Africa or elk in North America). Most migrations in Australia involve birds, although barriers caused by extensive habitat changes could affect some mammals that range widely, such as

kangaroos and even echidnas. Australia's unpredictable weather conditions, especially in the inland, has resulted in many birds, both passerine and non-passerine, becoming nomadic (corresponding to events such as flowering or fruiting of food plants or rising water levels) rather than following set routes and schedules, and are thus more difficult to plan for. We also have long-distance migratory birds (for instance, waders and swifts that migrate to and from Asian countries, and frugivorous pigeons and cuckoos which come from the north to breed in subtropical regions) and more localised migrations (from wintering lowland regions to the mountains for breeding, or between habitat types for breeding and non-breeding periods). Most birds are able to 'island-hop' between habitat patches more readily than mammals or reptiles, but have their limits: we need further studies on what these limits might be. Armed with current knowledge we can already make some recommendations on habitat patches that should be preserved along established migratory routes.

3.4.2 Supplemented food (intentional and accidental)

We have included the provision of food under habitat alteration because an augmentation of an animal's resources is essentially an alteration to its habitat. Supplementary feeding includes: deliberate feeding by tourists; the stealing of food from unwilling tourists; manipulation of habitat to provide more food by tourism operators and developers; leaving scraps around picnic tables and campsites; and leaving edible refuse in rubbish dumps. Waste disposal is a problem of tourism generally, not just wildlife tourism, but if it is the wildlife which draws people to a natural area, the dumping in such areas may increase, thus increasing the probability of the wildlife making use of it. All these forms of food supplementation are widespread in wildlife tourism in Australia, although generally unquantified. A study by Moore *et al*. (1997) found that 57% of all 'visitor-wildlife interactions' in Tasmania involve active feeding of wildlife by visitors.

The six conservation agency informants (out of a total of seven) who mentioned hand-feeding of animals as a problem (in response to question 1) made the following points (number of interviewees raising each issue are given in brackets):

- feeding of inappropriate foods (3);
- habituation (1);
- health issues (1);
- attraction of animals that could become dangerous (e.g. dingoes) (1); and
- hand-feeding dolphins could lead to boat accidents (1).

One conservation agency informant stressed that hand-feeding was very rarely a problem, especially in comparison to the general 'messing-up' of habitats, and felt that the positive effects outweighed the negatives. Some of the others felt strongly that hand-feeding was 'not on,' especially in natural areas.

The reasons for tourist feeding of wildlife can be broadly grouped into two major categories: the desire (for whatever purpose) of the tourists to have contact with or a close-up viewing of the animal, and the desire by both tourist and tourism operator for predictable viewing of wildlife. Duffus and Dearden (1990) state what is obvious to all tourism operators, that 'non-consumptive use of wildlife requires a predictable occurrence of the target species within a fairly small spatial area.' Many tour operators are faced with a situation where they know there is plenty of wildlife but can never be sure they will find any when taking their guests on tour. They can explain to their guests that they are seeking animals in the wild, not visiting a zoo, but there is still an uncomfortable feeling that their guests will be less than satisfied (and will not recommend their tours) if they do not encounter particular anticipated species. Restricting movements of animals by fences would often be illegal, as well as not giving the guests the feeling of seeing animals in the wild. It is tempting instead to provide feed at regular interval which will ensure, or at least increase the possibility of, the animals' presence at the right times. We have been told confidentially that some employees of wildlife tourism enterprises have been instructed to discreetly place food for animals but to tell clients the animals are not hand-fed.

Although we are not aware of any structured surveys on this topic, it would seem many tourists would prefer to see wild animals behaving naturally than half-domesticated animals gathering for a hand-out. A number of tour operators make considerable effort to provide such experience. For instance the guides of Adventure Charter Tours of Kangaroo Island work in pairs, one staying with guests while the other seeks out macropods resting in the shade and quietly summons the group to approach the habituated but un-fed animals for close viewing and photography (pers. obs.).

However, rather than launching into an all-out campaign (as a number of wildlife managers and conservationists have insisted that we should) for the prevention of hand-feeding of wildlife in all circumstances, we need to ask:

- What are the major concerns (either hypothetical or based on observation) of those who oppose hand-feeding (see Table 1)?

- Are there situations where some additional feeding is beneficial to wildlife (see Table 1), and if so is there a way of incorporating this into tourist experience?

- What information exists (or needs to be gathered) to establish whether these concerns or benefits are valid in general or in any given situation?

- Would it ever be possible to educate the majority of people (whether or not this is considered desirable) to refrain from feeding wildlife in all situations?

- Can the majority of people be educated that it is acceptable to feed in some situations but not others?

- What are the consequences if we do manage to put a stop to all hand-feeding of wildlife (that is, do the conservation and other benefits outweigh the costs in some situations?)

Information is lagging far behind opinion on this topic, but some of the major (largely untested) kinds of arguments are presented in Table 4.

Table 4: A summary of commonly used arguments for and against hand-feeding (note that many of these are speculative rather than demonstrated)

ARGUMENTS AGAINST	ARGUMENTS FOR
Ecological arguments • Population numbers of the species being fed may significantly decrease, through (a) inadequate diet, (b) creating a dependence on a resource which is later taken away, (c) animals learning inappropriate habits, or (d) by the spread of disease • Population numbers of the species being fed may significantly increase, causing stress by promoting aggression between individuals usually more widely-spaced • Population numbers of other species may increase or decrease in response to changes in the numbers or behaviour of the species being fed (whether through increased or decreased competition or predation, or through habitat damage) • Hand-feeding of hay, grains or fruits may result in exotic plants germinating and persisting in a natural area **Other arguments** • Some habituated animals can become nuisances or even dangerous in their demand for food, resulting in decreased visitor satisfaction and sometimes necessitating the removal of problem animals	**Ecological arguments** • Where habitats have already been significantly modified by human activity some provisioning of food may help certain animals through lean times, or help threatened populations to recover • In certain situations provisioning can lessen mortality at critical times such as after drought or bushfires – especially if this is caused by humans **Other arguments** • Allowing hand-feeding teaches people positive attitudes towards wild creatures instead of regarding them as nuisances, something to chase or shoot, or boring and unimportant, and they will then be more likely to support conservation measures • It is easier to educate visitors about certain features of animals when they are close • There seems to be a deep-seated need by some people for actual contact with wild creatures (this appears sometimes to be perceived as a spiritual need) • Some feel that by feeding a wild animal they are repaying some kind of debt for the destruction caused by their own species on others, or that they have a responsibility to help 'God's creatures'

ARGUMENTS AGAINST	ARGUMENTS FOR
• Undesirable behaviour (in this case feeding wildlife) in one place may encourage the same in inappropriate places • Allowing hand-feeding teaches people undesirable attitudes (seeing animals as playthings, or expecting them to 'perform' on demand for photos, rather than respecting them as wild creatures) • Hand-feeding results in wild animals becoming semi-tame, and no longer true representatives of wilderness • An almost sacred element of the world's 'wildness' is seen as being diminished by allowing wild animals to become tame or even to interact at all with humans	• Photographic opportunities are enhanced if animals are encouraged to come closer, especially when visitors have limited time available • Some animals are too unpredictable in their movements to guarantee sightings to international visitors with limited time available to seek for them unless attracted by hand-feeding • Some people will be unable or unwilling to make the necessary effort to see certain animals in the wild, and we thus miss opportunities to enhance their awareness of these animals

With so many intangibles involved, and especially without further research on the actual ecological, behavioural and health aspects, many will continue to hold simplified, often extreme and polarised, views.

Food provided for animals can lead to a decline in health, through either not being adequate nutritionally or by promoting the spread of disease. There have been fears of macropods developing the disease 'lumpy jaw' through a diet of processed carbohydrates such as bread and cake given by well-meaning tourists, although it is likely to be caused through infection (from concentration of wallabies around bread left lying on the ground) rather than the bread *per se* (A. Tribe, pers. comm.). Burger (1997) interviewed several people from wildlife sanctuaries and national parks, and also conducted a literature survey but could find no evidence that lumpy jaw is caused by eating bread. Fox (1982) reports that when an old lucerne patch was kept mown to encourage kangaroos and wallaroos near camping areas in the Warrumbungle Ranges, a vet found a significantly higher incidence of lumpy jaw in these crowded areas than elsewhere. Hand-fed brushtail

possums in Australian campgrounds tend to become over-populated, and this can result in stress-related disorders such as ulcers and hair loss due to unnaturally high interactions with rivals (K. Reid, pers. comm.). When wire cage traps were set with apples as baits on two separate occasions for badly-affected animals at one campground, approximately half a dozen other possums had to be immediately discouraged from preventing the entry of the target animal (pers. obs., RG) in marked contrast to most trapping attempts. Burger cites various papers (Orams 1994, Wilson 1994, Orams 1995, MBMPA 1997) warning about diseases transmitted by human breath to dolphins, as well as other references to the transition of disease from humans to other species (Skira and Smith 1991, Land for Wildlife 1992, Johnson 1995, Platt 1995, Ringwood and Wesley 1995, Moore *et al*. 1997). Inappropriate food can also have serious consequences for animals. The selection of frozen fish fed at Monkey Mia was formerly not nutritionally adequate, especially for nursing females and their young (Wilson 1994). Freezing of fish destroys metabolisable water and fat-soluble vitamins (MBMPA 1997). The degree to which animals depend on the food given to them will vary. Sanz (1998) found that although crimson rosellas and king parrots are hand-fed daily with oil-rich sunflower seeds at O'Reillys Rainforest Guesthouse (Lamington National Park, Queensland) they also eat a wide variety of natural foods: the situation may however be different from animals more distant from natural food sources.

A particular concern (for both conservation and animal welfare reasons) is the potential for animals to become so dependent on the hand-feeding that they lose their ability to forage for themselves. This is troublesome for several reasons:

- they may miss out on essential nutrients provided by wild foods;
- they may become over-weight or lethargic and thus less able to escape predators;
- they may starve if feeding is abruptly terminated; and
- their behavioural changes diminish their value in public education, scientific research and biodiversity conservation.

Knight and Temple (1995) cite Despain *et al*. (1986) on the dependency of grizzly bears on unintentional food supplements in Yellowstone National Park. 'Up until the early 1970s, a portion of the park's grizzly bear population subsisted, to varying degrees, on human food wastes or garbage dumps within the park. Following the sudden closures of the dumps by the National Park Service, there were expansions in the size of bear home ranges and decreases in body size, reproductive rate, and average litter size... In addition, bears had to relearn skills required to obtain live prey and carrion.' One dolphin at Monkey Mia, after becoming accustomed to hand-feeding, started begging at boats and was usually rewarded, ultimately becoming totally dependent on hand-feeding (Wilson 1994). On the other hand Brieze *et al*. (1995) found no evidence of any change (which is not the same as finding evidence of no change, as such results are sometimes interpreted) in the behavioural ecology of hand-fed dolphins at Tangalooma.

During a three-year study at Currumbin Sanctuary (Gold Coast, Queensland) over 200 lorikeets were caught near the hand-feeding site and banded (Cannon 1984). Cannon concluded that the permanent food source had probably reduced the nomadism of both species (rainbow and scaly-breasted), but not eliminated it, with returns of birds declining steadily over the subsequent two years. Birds marked to allow individual recognition generally did not visit the Sanctuary every day, even in the first few weeks after capture. Over 80 lorikeets from Brisbane were also released: nine were subsequently seen at the hand-feeding site, indicating that new birds arriving (through natural nomadic behaviour) would probably soon learn of the food source available by following experienced birds. The numbers of birds using the hand-feeding site fluctuated throughout the year, suggesting that the birds used it mainly when more natural foods were declining.

Over-population can readily occur when localities of scarcity become localities of abundance. Animals of the Australian outback have had to adapt for survival and reproduction in a region plagued by the world's most unpredictable rainfall. Drought can come at any time and may continue for years, so they must be ready to take advantage of a good rainy season whenever it might come. If conditions are consistently favourable, such as when stock-watering points are provided and remain after stock have been removed, species such as

the red kangaroo can breed very rapidly in some areas to numbers above that which was possible before white settlement. There are varying opinions as to whether this is cause for concern, and probably each case needs to be judged separately.

Animals can learn to associate certain noises and other cues with food, and this can lead to alteration of behaviour. Stationary minibuses are known to be used by lions and hyenas to locate potential prey (Marshall 1988). Bowles (1995) cites references to information on raptors learning that military activities flush prey species, and deer learning that the sound of chain-saws lead to easily-reached foliage. Certain carrion feeders such as vultures and hyenas are especially attracted to garbage dumps in Kenya, and even elephants are attracted to garbage near lodge kitchens (Sindiyo and Pertet 1984). Raccoons and skunks raid rubbish bins at night in Guanacatse, Costa Rica (pers. obs.) as well as many parts of the USA (pers. comm. with US tourists), and coatis quite boldly do so in front of tourists during daylight hours at Iguassu Falls, Argentina (pers. obs.). Possums, rodents (including some native species), seagulls, crows and other wildlife frequent some waste dumps in tourist areas of Australia. Sweatman (1996) noted that fish congregate at the tour operator pontoons when tourist boats arrive on the Great Barrier Reef, but concluded that this was not a problem as they do this naturally in other areas of good food supply.

Effects of food provisioning can be totally unpredicted. The planting of winter-fruiting shrubs in upland areas such as Armidale and Canberra seems to have enabled pied currawongs to remain in the district throughout winter, thus being present when small bushbirds are nesting in early spring, sometimes emptying every nest in each of several bushland patches (H. Recher, pers. comm.).

Hand-feeding sometimes causes further risks to wildlife. Hand-fed cassowaries may lose their shyness and fall prey to dogs. Cassowaries may also be attracted to roadsides and thus vulnerable to being hit by cars (Crome and Moore 1990). The same has happened to wallabies in campgrounds (Skira and Smith 1991). Quokkas on Rottnest Island have become accustomed to hand-feeding and are very tame, sometimes resting in the shade beneath parked vehicles (pers. obs.)

Some animals become very habituated and docile when fed frequently. Others (varying both within and between species) can become aggressive when they learn to associate humans with food but find that some humans are not so obliging, or for a variety of other reasons. Orams (1995 cited in Burger 1997) cites several references to chimpanzees, bears and macaques becoming aggressive when accustomed to hand-feeding. Knight and Temple (1995) cite Singer and Bratton (1980): 'of 107 personal injuries to humans by black bears in Great Smoky Mountains National Park, 35 occurred while people were either feeding or petting bears.'

A few Australian species are either known to be dangerous or have potential for some degree of danger, including:

- Dingoes (QPWS 1999a): At Fraser Island (Qld) there have in recent years been many attacks on people by dingoes, culminating in a highly publicised death of a boy in 2001. It is generally accepted that the attacks have been facilitated through accidental and deliberate feeding of dingoes by humans, causing them to loose their fear and associate people with food (e.g. Moore *et al*. 1997). A similar habituation probably facilitated the taking of a baby by a dingo at Uluru a couple of decades ago.

- Large male kangaroos: There have been many scratches caused by previously hand-fed kangaroos demanding food (or to a lesser degree by adolescent males wanting to play-fight: pers. obs.). Occasionally large males cause serious injury: they can be very large, very strong and quite alarming, and an energetic kick can be dangerous.

- Dolphins: While popular partly for their reputation of friendly and gentle behaviour, dolphins have on occasion become aggressive with humans in hand-feeding situations. Orams *et al*. (1996) cites Lockyer's description of a case where a dolphin on the English coast took to occasionally butting people in the chest, pushing them away from the shore and not allowing them to return. Some dolphins at Tangalooma Wild Dolphin Resort (Moreton Island, Queensland) have indulged in 'pushy' behaviour (Orams *et al*. 1996), but regulation of tourist behaviour has been instrumental in diminishing this problem (see Section 4.3.2).

- Cassowaries: Of 150 attacks on humans by cassowaries surveyed by Kofron (1999), 75% were by birds which had previously been fed by humans, and Kofron reports that aggressive behaviour of cassowaries trying to solicit food from humans is a recent phenomenon, the first definite case being reported in 1985.

- Crocodiles: Tourists are presumably never encouraged to feed crocodiles, but some tour operators do so on river cruises, and there is a concern that the practice could lead to crocodiles approaching other boats and leaping for any portion of human anatomy that happens to be within reach.

- Goannas: These large lizards have powerful legs and large claws capable of inflicting deep scratches, and teeth capable of strong bites. In addition, their teeth and claws frequently harbour bacteria from residual pieces of decaying flesh from a previous meal, and serious infection can result (they are in the same family as the komodo dragon, which habitually kills its prey by inflicting such disease-ridden bites). They do not seek to attack humans, but could do so inadvertently while being hand-fed, or deliberately if a camper or picnicker over-estimated their tameness and tried to handle one for a photograph or to remove it from a campsite.

Various other animals are capable of inflicting wounds, usually minor. The above might appear to be a problem for the humans rather than the wildlife, but 'problem' animals often end up being re-located or killed by managers who are obliged to protect the public (e.g. dingoes on Fraser Island). Sindiyo and Pertet (1984) refer to the feeding of wildlife causing a problem in parts of Kenya, with habituated animals being removed. Marshall (1988) records that a large male elephant fed by tourists in the 1950s 'took to shaking and overturning cars in the hope of finding bananas, and had to be destroyed.'

A veto on hand-feeding in national parks and other areas of protected natural habitat would in most cases seem highly desirable. But if there is a deep psychological need which is satisfied by feeding wildlife it may be very difficult to eradicate in other areas. Also, if the satisfaction of this need significantly increases people's positive outlook on wildlife, the net conservation benefit of controlled feeding

may be positive. A surprisingly large percentage (38%) of Brisbane residents buy food for wild animals (birds, possums etc.) (D. Jones and P. Howard, pers. comm.). Howard and Jones (2000) found that the most commonly given reason for feeding wildlife by residents of Southeast Queensland was to make up for loss or destruction of wildlife. We do not know the degree to which such sentiments influence the feeding of wildlife by tourists. Howard and Jones suggest that legislative measures will be of limited effect, especially amongst those who believe they are 'helping God's creatures' by feeding them. Further, if many people are not interested in animals unless they can 'do' something with them, are some of these likely to turn to more destructive interactions (e.g. children throwing stones at birds) or simply find them boring and be less inclined to take note of conservation messages? The last sentence is presented in hypothetical vein: we do not know the answer. Indeed, far more research is required in all these avenues before anyone can reasonably talk as confidently as many already do. There does however seem to be something inconsistent – on ecological grounds at least – about being allowed to kill large numbers of fish for sport fishing but never to feed them or replacing forests with pastures and hoofed animals, and then saying it is wrong to throw an occasional piece of apple to a possum on a cattle station farm-stay because this is interfering with nature.

3.5 Summary Of Actual And Potential Negative Effects Of Wildlife Tourism On Wildlife

The seriousness of negative effects on wildlife can vary from mild discomfort or inconvenience to individual animals through to local or even global extinction of a species. It is not always easy to determine where a particular effect is likely to lie along this spectrum, as relatively minor stresses may be symptoms of, or cumulatively lead to, more serious problems (see section 3.1.1). The vulnerability of the species concerned is an important factor in considering conservation consequences: disruption of a local bilby or numbat population would obviously be of greater concern than disruption of a local population of common brushtail possums or grey kangaroos.

In the interests of the tourism industry it is as well to remember also that the reliability of viewing particular animals (even the most common species) in a local area may be critical to the sustainability of

local tourism operations. Mild stress which causes animals to shift their activities deeper into the forest during spotlighting sessions, or flee at the approach of vehicles, may or may not important in terms of animal welfare or conservation, but it may result in a reduction in the quality of the tourist experience. In such cases, conservation, welfare and tourism goals will be in harmony. In cases of conflict, the onus should be on the industry to ensure that conservation and welfare impacts will be minimised. Activities which may cause serious welfare problems or reduce populations of threatened wildlife should not be permitted regardless of the interests of tourists or tourism operators. In this context is should also be noted that long-term interests of the industry will also be better served by protecting the wildlife that tourists wish to see. However, species which are of lesser interest to tourists, but sharing the ecosystem with those being viewed, should also be protected from potentially damaging activities, whether or not they are likely to be of importance to the industry.

Some of the major issues of concern in terms of negative effects of wildlife tourism on wildlife in Australia would appear to be:

- handfeeding (which has the potential to affect not only the animals being fed, but indirectly other species sharing the ecosystem, although it is not necessarily a conservation or welfare problem in many situations);

- spotlighting (of special concern where flying and gliding animals may be temporarily blinded, or where animals are discouraged from using favoured feeding areas);

- temporary desertion of eggs or young (allowing predation or exposure to extreme temperatures);

- depletion of energy and nutrient reserves (e.g. from disruption of foraging activities);

- local habitat disturbance; and

- effects of tourist activity on unseen cryptic species that are not the primary focus of the tourism, and of which tourists and operators may remain unaware.

This section of the report summarises our current state of knowledge relating to these and other issues of wildlife tourism in Australia. As is to be expected in any relatively new field of study, we know quite a lot about a few aspects and very little about many others. There may well be overall positive effects on conservation associated with tourism activities, but those who conduct such activities should be conversant with the potential problems and ever-alert to ideas for decreasing their impacts.

Handfeeding

This is a highly emotional issue, with individuals holding extreme views in both directions. Many of the arguments do not involve ecological or physiological factors, and while their importance is recognised they are beyond the scope of this paper. Studies on nutritional and pathological aspects of the hand-feeding of dolphins, lorikeets and macropodids in Australia (and primates and others overseas) have indicated that problems of malnutrition and disease can arise, but that appropriate regulation of hand-feeding activities can mitigate or possibly eliminate these. Studies of dolphins and anecdotal evidence of possums and other animals indicate that un-natural crowding can lead to increased stress levels and aggressive behaviour between animals. It is known that some animals in Australia and overseas have also become dangerous to humans when they have become habituated by hand-feeding, sometimes necessitating their removal from the locality. Australian examples include dingoes, cassowaries and large male kangaroos. Problems of dependency on food provided either intentionally or inadvertently (e.g. through rubbish dumps) have been shown for overseas animals, such as bears, but despite much speculation on the same in Australia there has not to our knowledge been any detailed studies on this. The effects of over-population of a hand-fed species on other species in the same locality has likewise been a topic of much discussion and speculation but has not been well researched either within Australia or elsewhere.

Spotlighting

Spotlighting is generally seen as a harmless activity, but it has the potential to disrupt social activities, drive animals repeatedly from their foraging areas, and cause temporary loss of vision. Loss of vision could be particularly hazardous for flying and gliding animals,

involving events which occur after the group has left the animals, and thus not obvious even to an experienced guide. There appears to be very little research on the effects of spotlighting either in Australia or internationally. The need for further research in Australia is especially critical, because the nocturnal habits of most of our native mammals is prompting an ever-increasing number of tour operators (including farm-stays) to include spotlighting activities. Wilson's (1999) study has increased our knowledge of the responses of possums to light intensity and colour, and to various sounds associated with spotlighting activities. Further research is needed on other mammals and birds, especially those which fly or glide.

Desertion of eggs or young, and other disruption of breeding behaviour

There are sufficient examples from the overseas literature on temporary nest desertion by aquatic birds, marine birds, raptors and in response to recreationists and subsequent predation of eggs or young, to caution us against allowing close approach to breeding animals of these categories in Australia. Some of the overseas studies involve species (e.g. ospreys, crested grebes) which also occur here. How close is 'safe' for each species at different stages of the breeding cycle is however a question that needs further research. Research on penguins in the Antarctic and albatrosses in New Zealand has indicated decreases in breeding success due to tourism and other human activities. The effect of bird observers and other forest visitors on the breeding of small bushbirds and small mammals such as dasyurids and native rodents is largely unknown.

Disruption of foraging

There are a number of international examples of mammals and birds (especially aquatic or marine birds) being driven from their foraging areas or prevented from catching prey by wildlife tourists and other recreationists. Information on Australian animals is sparse. Loss of energy or nutrient reserves appears to be a serious problem for certain animals such as seals and penguins which feed for long hours in cold water, or for birds feeding nestlings or preparing for migration. We can infer from overseas studies as well as local anecdotal evidence that powerboats are more likely than rowing boats to drive waterbirds from their foraging areas, and that human activities in early morning are more likely to disrupt the foraging of bushbirds or waterbirds than

activities later in the day. We know far too little about effects of disturbance on cryptic species. A further complication is that effects on any species of animal are likely to vary between populations, according to the animals' previous experience with humans as well as other factors such as openness of habitat. There are to date no quantitative studies on the energetic costs of varying levels of disturbance to foraging animals, the distance to which various populations can be approached without causing undue stress levels (except for penguins: Giese 1996), or the extent to which this is actually happening during wildlife tourism activities.

Vegetation and soil changes

It is well-known from many sources that the primary cause of biodiversity loss throughout the world is habitat destruction, and much is known about habitat requirements of Australian terrestrial vertebrates. Wildlife tourism seems to be a very minor cause of habitat removal other than the clearing of small areas for lodges, campsites, picnic tables or car-parks, although it can lead to habitat modification over a wide area if the fire regime is altered or the understorey shrubs and old trees are removed for safety reasons near tourist accommodation. Deliberate cutting and burning to encourage grass over woody plants in order to attract kangaroos could disadvantage species which need the shrubs. Factors such as soil compaction by human feet and off-road vehicles, collection of wood for campfires, disruption of migratory or other dispersal routes by habitat fragmentation, and the introduction of seeds and spores of feral plants and fungi have not been well-studied in Australia. Overseas literature suggests they could have serious local impacts. In situations where small habitat remnants preserve populations of threatened species, even a localised effect could entail serious conservation risks.

Accidents with vehicles

Anecdotal evidence suggests that wildlife tourism plays only a minor role in roadkills in Australia. Problems can occur however where additional roads and car-parks are provided in areas of high wildlife abundance, increasing the chances of animals being 'spooked' by other activities and hurrying across roads, or becoming habituated to the point where they are less likely to move away from an approaching vehicle. Overseas projects to provide safe crossings for

deer and other wildlife could be examined for their potential in Australia. Overseas studies on off-road vehicles and boat accidents (especially collisions with manatees, which are related to our dugongs) suggest that similar problems could occur in Australia.

Hunting, fishing and collecting

Australia has legislation to protect native vertebrates from sport-shooting or collection without appropriate licenses, although legal activities can be difficult to police, especially in sparsely-populated regions. The shooting of feral animals may well have an important conservation benefit, unless potential revenue from hunting prompts land-holders to encourage populations of pest species on their properties. Concern has been expressed in overseas literature about the effects on the rest of the social group when certain individuals are lost, the effects on genetic structure of populations when the most handsome individuals are sought as trophies, and the effects of gunfire on non-target species. In Australia concern has been expressed about misidentification (e.g. of ducks) leading to the shooting of non-target species, and lead poisoning of non-target species feeding in heavily-hunted areas. Animal welfare concerns include some of the above plus the slow death of animals that escape after being injured. Literature on the issue of hunting tends to be polarised. There appears to be little research on Australian fauna to facilitate firm recommendations.

Other direct causes of injury or mortality

Trampling by tourists can be a problem on coral reefs, perhaps especially wildlife tourists who are keen to investigate the invertebrates above the water between diving activities. Trampling of platypus burrows on creek banks, eggs of ground-nesting birds, crab burrows on beaches, or a variety of invertebrate burrows around campgrounds, is less readily observed, and we know too little of the effects in Australia. There is also little known about the effects of insecticides used for mosquitoes on other insect life and the food chains that may depend on them.

In conclusion

In short, we know enough to be able to advise that tourism activities should proceed with caution, recognise some of the warning signs of trouble, and offer some general guidelines for management. Much

further research however is needed on Australian species in a variety of scenarios to refine these guidelines with any confidence. Once again, the negative effects should be viewed in the context of alternative land uses, and the positive contributions that wildlife tourism can make to wildlife conservation.

4. MANAGING THE NEGATIVE EFFECTS OF WILDLIFE TOURISM ON WILDLIFE

4.1 Introduction

A comprehensive system of managing natural resources involves not only deciding what management actions are appropriate and implementing them, but also an ongoing system of monitoring and evaluation to determine whether management objectives are being met. It should also include considerations relating to incorporation of perspectives of different stakeholders, since management occurs not in isolation, but in a broader socio-political environment. Thus this section first reviews management actions (section 4.2), monitoring (section 4.3) and the role of stakeholders (section 4.4), and then considers how they can be integrated into an overall management framework (section 4.5). Other requirements for effectiveness of management are reviewed in section 4.6. Opinions of conservation agency informants regarding effectiveness of, and obstacles to sustainable management of wildlife tourism in Australia are presented in section 4.7. Recommendations relating to management are included in section 5.2. Where possible, examples relating to wildlife tourism – and specifically wildlife tourism in Australia - are given, although this is limited by the fact that documentation of these is often unavailable. Tourism sites whose country is not specified are all in Australia.

4.2 Management Actions

The management approaches that are available for limiting the negative effects of wildlife tourism on wildlife and habitats are essentially the same as those for management of negative effects of nature-based recreation on the natural environment, though some details of applications are specific to wildlife. These can be classified according to:

1. **what** they attempt to manage (section 4.2.1); and

2. **how** they attempt to do this (section 4.2.2).

4.2.1 What should be managed?

Management can be directed either at (a) the people (visitors and/or operators) potentially creating negative effects or (b) the wildlife or habitat that is the focus of the tourism experience. Where the goal of management is to enhance the visitor experience, actions to manage the wildlife itself are sometimes employed (e.g. providing food, training animals to allow close approach by people). However, where the goal is to minimise negative effects of tourism on wildlife, the emphasis is normally on management of visitors – either directly or through influencing tourism operators. Thus the rest of this section focuses mainly on management of visitors and operators.

Managing wildlife and habitats

Although managing visitors is usually seen as the principal way to limit negative effects of tourism on the natural environment, in some cases it may also be helpful to manage the natural environment (including the wildlife) itself. This may involve limiting the susceptibility of the natural environment to negative effects, or actively rehabilitating the environment after damage has been done.

Manipulating the environment to limit its susceptibility to negative effects caused by visitors is often known as 'hardening', and normally involves physical structures or modifications (see section 4.2.2). Hardening the wildlife can also be undertaken through some form of conditioning. This can be used either to reduce the extent to which animals react to the presence of humans (habituation) or to train them to avoid people displaying activities that might be harmful to them (through aversive conditioning). Another measure most likely to be applicable to captive situations is to manage individual animals to control their exposure to tourism. Examples of all these measures are given in section 4.2.2.

Direct deterrents or rewards can also be used to manipulate wild animals in such a way that they avoid harmful interactions with humans. This can include use of aversive stimuli such as certain sounds (subsection below on managing visitor behaviour) or lights (section 4.2.2; subsection on physical alterations). In theory it could also involve techniques such as chasing or enticing animals away from sites of disruptive human contact.

Direct management of the natural environment may be required in some cases to redress environmental damage caused by visitors, which might otherwise lead to negative effects on wildlife. Potential effects include pollution, introduction of weeds, erosion, trampling of vegetation and removal of firewood. In extreme cases, where past tourism activities have caused declines of wildlife populations, it is conceivable that measures to rehabilitate wildlife directly might be needed (such as temporary supplementary feeding or reintroduction). In cases where factors other than tourism have caused environmental degradation, direct management of the natural environment may also be needed. However, it is preferable to manage visitation in such a way that the need to resort to such measures does not arise.

In addition, if the targeted wildlife population occurs in a restricted area of good quality habitat, it might be appropriate to restore habitat away from the tourism contact zone, ensuring that the wildlife have a 'refuge' from the influences of tourism (Ream 1979).

Managing Visitors and Operators

In general, management to mitigate the effects of a causal agent of disturbance involves manipulating one or more of the characteristics of the causal agent, such as its intensity, duration, frequency, predictability, timing and/or scale (Hulsman *in review*).

Management of visitors and/or operators is in practice generally equivalent to managing the causal agent of disturbance. It can be designed to influence one or more of the following:

- numbers of visitors;
- spatial distribution of visitors;
- temporal distribution of visitors;
- behaviour of visitors or operators ;
- expectations of visitors regarding their wildlife experience;
- attitudes of visitors or operators;

- design of wildlife tourism experiences; and

- involvement of operators and tourists in measures to actively conserve species or habitats affected by wildlife tourism

Managing Visitor Numbers

Since the magnitude of negative effects of nature-based recreation on the natural environment often depends to some extent on the number of people present (Cole 1992, WTO and UNEP 1992), measures to limit the number of visitors have been a common focus of management efforts. A considerable body of research has been undertaken to try to determine 'carrying capacities' of different areas in relation to visitors (Mieczkowski 1995). Carrying capacity in this sense refers to a threshold level of visitor numbers and related infrastructure that, if exceeded, will cause the resource base to deteriorate. This deterioration can relate to the natural environment (known as 'ecological carrying capacity'), visitor satisfaction or host communities (Ceballos-Lascurain 1996). The concept has its limitations (see below), but in cases where there is a strong relationship between visitor numbers and negative impacts, setting a carrying capacity and keeping visitor numbers below this can be a simple and practical way of setting limits on negative effects of visitors on the natural environment.

In management of visitor numbers for nature-based recreation (such as visitation to a particular national park), limits on visitor numbers most often apply to some standard period of time such as a day or year. For example the Master Plan of the Galapagos National Park (Ecuador) called for a maximum of 12,000 visitors per year (De Groot 1983). The International Ecotourism Society (TIES 2001) reports that limits are set to the numbers of ships visiting the Galapagos Islands, and that cruise liners to the Antarctic operate under self-imposed guidelines to limit the number of passengers. By contrast, visitor numbers are not generally limited by regulation in Australian protected areas. However there are limits set for total numbers of visitors to certain popular attractions based on viewing of free-ranging wildlife. Management guidelines for Mon Repos turtle rookery specify a maximum of 300 visitors in the colony at any one time before midnight, and a maximum of 100 after midnight (QPWS

1997). Seal Bay (Kangaroo Island) allows a maximum of 100 visitors on the beach with the sea lion colony at one time (J. Crocker, pers. comm.).

However even restricting considerations to environmental effects (as is relevant here), it has proved difficult to assign fixed carrying capacities to areas used for nature-based tourism, unless this is set by simple physical considerations such as parking area or water availability. For example the number of visitors allowed at the Phillip Island Penguin Reserve apparently corresponds to the number of people that can be accommodated on the system of boardwalks and viewing areas (pers. obs.). The difficulties in assigning a carrying capacity for a particular site are mostly a result of the following factors:

- Research has demonstrated that only a weak relationship exists between visitor numbers and environmental impacts (Vaske *et al*. 1995).

- Carrying capacity is usually very site-specific and therefore needs to be ascertained for each individual site.

- Carrying capacity varies even within sites, depending on factors such as season, nature of infrastructure, hardening practices, type of activity and visitor behaviour (Mieczkowski 1995, Ceballos-Lascurain 1996).

- A determination still needs to be made for each situation about what magnitude of negative effects should be considered acceptable.

In wildlife tourism, the size and frequency of visitation of individual groups of visitors (or boats) encountering the animals is often likely to be more critical than overall numbers of visitors. At Seal Bay, for example, visitor group size is regulated (Oaten 1993). At Mon Repos, the maximum group size to be allowed near each turtle is 70 people (QPWS 1997). Whether many small groups or fewer large groups have a more disturbing effect will presumably depend on the species and situation. De Groot (1983) reports that one of the biggest threats to the Galapagos Islands is the rapidly increasing number of tourist boats carrying only 6-12 passengers (due apparently to greater difficulties in ensuring high standards among these small operators),

although he does not present scientific evidence of this. In other cases, as long as group size is kept below some threshold level, the effects on wildlife may be negligible. Unfortunately very few management decisions regarding the optimal balance of group size, frequency and distribution are based on research.

Managing spatial distribution of visitors

Managing the spatial distribution of visitors to minimise their negative effects on wildlife indirectly affects the number of visitors at various locations. Management of distribution can occur at a number of spatial scales, ranging from across a whole country or region to within the habitat of a single wildlife population.

The strictest form of managing the distribution of visitors is to prevent access to certain areas. Some areas are particularly vulnerable, either because of fragile ecosystems, or the concentration of biodiversity or vulnerable populations into a small area, or both. For example, less than 2% of Antarctica is ice-free and the use of such areas by wildlife is relatively high (Hall 1992), so some authors have argued that such areas should be kept relatively free of tourism. Some species (particularly those with a threatened status) or populations (such as breeding colonies of some species) may also be particularly vulnerable to disturbance such that development of tourism is considered too risky. As long as uncertainty exists about threats of tourism on certain species in their natural environment, tourism based on these species may need to be restricted to animals in captivity.

Without actually preventing access, strategies can be adopted to influence the spatial distribution of visitors. As visitor pressures on Australian national parks grow, it has been argued that there should be a relative shift in the emphasis of nature-based recreation to State forests (Buckley 2000). Similarly since private land does not have the conservation protection status of national parks and other legally protected areas, providing incentives to build wildlife tourism on private land as opposed to its further growth in protected areas may be desirable. In the United States, recreationists are turning increasingly to private forest land as visitor numbers to public forest areas increase (Lassiter 1987).

Various measures, especially zoning, are used to restrict visitor activities to certain parts of a protected area (section 4.2.2). Views differ on how visitor impacts within natural areas should be spatially dispersed to minimise overall negative effects on the natural environment. Buchanan (1979) proposes that visitor activity should be concentrated in the corner of a reserve, which minimises the length of the edge between the relatively undisturbed natural habitat and the disturbed site, and that disturbed areas should not split a natural area into separate fragments. At all spatial scales, an often controversial but crucial question is whether visitors should be dispersed widely and diffusely, or kept as spatially concentrated as possible. On the one hand, all else being equal, a high level of dispersion usually leads to a lower intensity of impact per unit area, and provides a more satisfying experience for those visitors who wish to avoid crowds (Mieczkowski 1995). Thus in the Amboseli Game Park in Kenya during the late 1970s it was estimated that 80% of visitors used only 10% of the park's area, leading to a deliberate strategy of encouraging greater dispersion of visitors within the Park. This reportedly allowed the total number of visitors to the Park to increase threefold for the same level of impact (Todd 1989). On the other hand, if these levels of impacts are sufficient to be of concern, such as for species of wildlife that are particularly sensitive to disturbance, a dispersion strategy may be detrimental to wildlife because relatively few areas are left undisturbed. Given that the relationship between levels of use and impacts is often curvilinear (so that the additional impacts of extra visitors become smaller as the number of visitors increases) it may well be better in many cases to concentrate use (Hammitt and Cole 1987). Similarly if the impacts have cumulative effects over space, such as when a migratory route is partially 'blocked' by disturbance in a range of locations, then dispersion may be undesirable. Concentrating tourists in small areas also makes management measures to control and discourage inappropriate behaviour easier to apply and less costly (Mieczkowski 1995). In cases where a population's range includes areas away from sites of visitor activity, the population as a whole can remain secure even if there are some detrimental effects at the visited site. Given inadequacies in knowledge about many aspects of effects of visitors on wildlife, a concentration strategy may therefore be less risky in terms of conservation.

The optimal answer to the dispersion question depends partly on the scale involved. For example Mieczkowski (1995) recommends that on an international scale there should be a move towards greater dispersion of tourism to decrease the negative effects on sites that are currently overcrowded. In terms of wildlife tourism, this might include, for example, shifting some of the visitation from African safaris to wildlife tourism experiences in Australia. Within countries, Mieczkowski recommends 'decentralised concentration', where tourists are concentrated in particular sites with good infrastructure and services, but able to disperse within neighbouring areas. Within the habitat of wildlife population(s), steps can be taken to keep visitor activity away from the most sensitive areas, such as breeding or foraging areas. Also by ensuring that visitors keep to designated areas or paths, animals can learn that they are 'safe' if they keep away from these areas (cf Gabrielsen and Smith 1995). At the smallest scale, measures can be taken to prevent or inhibit visitors from getting so close to wildlife that they have a disturbing effect.

Management bodies in Australia adopt both dispersion and concentration strategies in different situations. A default 'concentration' strategy has arisen for several species that are the focus of major wildlife tourism attractions: nesting sea turtles (with tourism focused at Mon Repos, Queensland), little penguins (Phillip Island Nature Park, VIC) and Australian sea lions (Seal Bay, Kangaroo Island). By contrast, marine mammal watching is becoming increasingly dispersed now that management authorities are placing limits on numbers of operators in some popular areas such as Hervey Bay in Queensland. However there has to our knowledge been no strategic planning or research to determine the optimum distributions of visitors in terms of wildlife impacts.

Managing temporal distribution of visitors

Many animals have particular sensitive stages in their life cycles or certain seasons of the year (such as breeding times) when they are most vulnerable to disturbance (section 3.2.4) and thus visitation levels may need to be reduced at such times. Gabrielsen and Smith (1995) suggest that for many species of birds and mammals such restrictions should apply during the immediate postnatal periods in mammals and the breeding period in birds. This may sometimes lead to a conflict with visitor demand, since it is often the concentration of

large numbers of animals and the prevalence of interesting behaviours that appeal to visitors. Typically, Australian animals are less seasonal in their habits than are those in the Northern hemisphere (due to a lesser degree of seasonality of climate) and thus the need to manage the temporal distribution of visitors in relation to wildlife is probably less frequent. The relative lack of seasonality however brings new challenges for management, as it means some animals may need protection from tourism pressure for more extended periods, and that the most sensitive periods in any particular year are more difficult to predict.

Managing visitor behaviour

One way to limit negative effects of visitors on the natural environment is to manage the types of activities engaged in by visitors. Once visitors are in the vicinity of wild animals, various aspects of their behaviour may be important in affecting the extent to which the animals are disturbed (section 3.2.1). Common management recommendations relating to behaviour of wildlife tourists include: keeping noise levels low or avoiding sudden noises (Bowles 1995), maintaining a specified minimum distance between visitors and wildlife, and avoiding touching or feeding of animals. For example, the minimum distance from which visitors are allowed to view sea lions at Seal Bay is 6m, although guides are also instructed to judge the situation and keep visitors further away if the need arises (Berris 2001). Other recommendations have been developed for particular species. For example Giese (2000) recommends crouching while approaching penguins, and looking for certain behavioural signs that the birds may be stressed. Hulsman (pers.comm.) also suggested the latter for seabirds in a 1984 report to GBRMPA and EPA but then found most rangers unable to detect the subtle changes in the birds' behaviour. At Tangalooma Resort, a practice used to reduce aggressive behaviour of handfed wild dolphins is to instruct visitors to spread out in a line (Orams 1995 cited in Burger 1997). Existing knowledge of behavioural responses of other species to visitors could be used to develop guidelines. For example, tourists wishing to take photographs of kangaroos could be advised to approach only to a distance where the kangaroos first raise their heads to stare (see Higginbottom *et al*. 2001c).

Another way to manage visitor behaviour is to manage their equipment. Restrictions can be placed on the type of equipment used, such as the type of vehicle, clothing worn, wattage of spotlights and the carrying of firearms. The 'behaviour' of the equipment that tourist groups use can also be managed. For example warning devices on cars (Bowles 1995) or measures to reduce vehicle speed such as road signs and road modifications (O'Shea 1995) may reduce the incidence of mortality due to vehicle collisions. A 'Shu-Roo' device has been developed in Australia, whereby an ultrasonic frequency is emitted from vehicles, which is meant to act as a deterrent to kangaroos. However there is no independent scientific evidence to date to indicate that this device is effective (H. Bender, pers. comm.).

As well as speed, the orientation and appropriate use of gears (using a neutral gear in the vicinity of whales) for commercial whale watching boats is regulated (*Environmental Protection and Biodiversity Conservation Act 1999* (Cwth), *Nature Conservation Act 1992* (QLD) and *Wildlife Conservation Act 1950* (WA)). Knowledge of the response of nesting turtles to lights has been used to develop detailed guidelines on appropriate use of torches and photographic lights by visitors (QPWS 1996, 1997, 2000a). Other guidelines relating to use of equipment may be advisable. For example, flashes on cameras could be prohibited in cases where this is likely to be stressful to the species in question, especially given that infra-red capability is now readily available for video cameras.

Managing visitor expectations and attitudes

A key problem in minimising impacts seems to be that visitors often have unrealistically high expectations of wildlife viewing (Frost 1999, Higginbottom *et al*. 2001a, Moscardo *et al*. 2001). They may expect to get closer to animals than is possible without stressing them, or they may expect to be able to feed or handle them. To some extent expectations depend on belief systems, attitudes and motivations in relation to environmental issues (Hammitt *et al*. 1993). Educational measures to modify these expectations and attitudes can be an indirect means of managing visitor behaviour, both during the wildlife tourism experience in question and potentially in terms of future behaviour relating to wildlife (Orams 1996, Moscardo *et al*. 2001).

Managing design of wildlife tourism experiences
Operators or management authorities can in some cases design the wildlife tourism experience itself to minimise negative effects on wildlife. Wildlife viewing locations or routes can be selected that limit the impacts of visitors. Orams *et al*. (1996) found that aggressive behaviour by dolphins at Tangalooma could be reduced by ensuring that encounters with tourists occurred only in shallow water, and the design of the encounter was changed accordingly. Visual shields of various forms can be used to reduce the effects of human activities on many wildlife species (Knight and Temple 1995). Technology can be used to provide 'close-up' viewing while maintaining a distance from the animals. Use of some of these physical means to manage impacts is detailed further in section 4.2.2.

In order to design wildlife tourism experiences to minimise impacts, good knowledge of, and careful consideration of the species' behaviour and ecology is needed. Green *et al*. (2001) have prepared a preliminary 'tourism classification of Australian wildlife' that provides guidance to the sorts of considerations for different kinds of Australian native animals. These need to be supplemented by local knowledge, and by further reading on the species occurring in the area.

A more extreme way of designing the wildlife tourism experience to minimise impacts on the wildlife is to make creative use of captive animals or remote viewing as substitution experiences, so that visitors are less dependent on close encounters with free-ranging animals for their satisfaction. For example Kenchington (1989) suggests for the Galapagos Islands that captive animals could be used to show the differences between tortoises, finches and iguanas on the different islands (relating to Darwin's early speculations about evolution by natural selection). Visits to all but a few relatively robust islands could then be restricted to a lesser number of seriously interested visitors.

Managing involvement of operators and tourists in conservation of species or habitats affected by wildlife tourism
The emphasis in managing impacts of nature based tourism on the natural environment is normally on finding ways to reduce expected negative effects. However in some cases it may be possible for tourists and/or operators to undertake activities that actually lead to a net positive effect on the natural environment and wildlife. This can occur

particularly through direct involvement in conservation-related work or research, or through maximising revenue from tourism that is channelled into conservation. This issue is explored in more detail in Higginbottom *et al*. (2001b).

In particular, operators who undertake wildlife tourism on their own land are often in a position to be able to rehabilitate that land and thus increase its conservation value. This is especially beneficial if the land is adjacent to existing protected areas (as opposed to fragments a few kilometres away), thus increasing the total area of effective wildlife habitat. If, however, the property includes habitat not protected elsewhere, is quite remote from protected areas (and thus likely to protect a different suite of species), is likely to be a 'stepping stone' for migratory or nomadic species, or is of substantial size, its very remoteness might confer special conservation benefits. Measures to encourage and support land rehabilitation by tourism operators can thus lead to net conservation benefits. As well as encouraging more retention of native habitat generally, this has the potential to take some of the visitor pressure off national parks and other reserves.

4.2.2 How should management be carried out?

There is a range of different approaches which separately or in various combinations can be used to manage negative effects of wildlife tourism on wildlife, focusing on one or more of the variables reviewed in section 4.2.1:

- physical alterations;
- active management of wildlife or the natural environment;
- external regulation;
- industry and individual self-regulation;
- economic instruments;
- education;
- marketing;

- use of environmentally responsible operators and guides; and
- cooperative agreements.

Physical alterations
Availability of access points, walking trails or roads can be used to influence numbers and distribution of tourists within an area, keeping large numbers of people away from sensitive areas or dangerous wildlife. Similarly, the location of accommodation and other facilities will often have a major influence on the intensity of use of different areas. The neglect or improvement of any of these structures that support visitors is a management decision that can be used to influence the distribution and intensity of visitor impacts.

Construction of physical structures can be used to harden the natural environment in relation to potential negative impacts. Commonly used engineering measures to reduce such impacts from nature-based recreation are: road surfacing, track construction, fencing and provision of toilets and shelters. Some particularly vulnerable wildlife colonies are fenced off to prevent access by visitors at sensitive times, such as for least terns at the start of the breeding season in parts of the USA (Burger 1995) and for little terns on Rigby Island in Victoria, Australia (Waldegrave-Knight 1997). In natural areas where wildlife viewing occurs, careful construction and placement of boardwalks and platforms can be used to limit habitat damage by visitors, as well as to keep them away from particularly sensitive areas of habitat. Boardwalks are used for this purpose at several of Australia's major free-ranging wildlife attractions, including Seal Bay and the Phillip Island Penguin Reserve. Hardening measures designed to minimise impacts of reef viewing boats in the Great Barrier Reef Marine Park on the reef include requirements to use fixed pontoons or moorings as bases for viewing of underwater life, and to locate these in areas where damage will be minimal (Crabtree 1995).

Physical modifications to roads are commonly used to reduce the risk of vehicles colliding with wildlife. Lehnert and Bissonette (1997) showed that special 'deer-crossings' on major roads in Utah were very effective in reducing fatal collisions. Motorists are alerted to the crossings by traffic signs while approaching them. Deer are channeled by funnel-shaped fencing to the correct area to cross the road, and

deterred from straying once close to the road by cobblestones (which had been previously found to be a deterrent) on each side of the path they are to follow. Lines painted across the road serve both to further alert drivers to the crossing and to guide deer directly across the road to the correct path and beyond. Anderson (1991) found that deer that at first were reluctant to use highway underpasses were successfully encouraged to do so by the installation of mirrors to give the impression other deer were using them. Underpasses for mountain goats to traverse highways have been successful in Glacier National Park, USA (Pedevillano and Wright 1987). A study prior to the construction of the underpass had shown goats to make successful crossings only 74% of the time (the rest turning back and not attempting to cross). Pedevillano and Wright found in contrast that all goats arriving at the highway during their study eventually made successful crossings, even if hesitant at first. In Australia, modifications such as road underpasses, a tunnel to allow movement of pygmy possums under a ski slope at Mount Hotham and 'koala ladders' (structures allowing koalas to climb over median strip barriers) are also used, though their effectiveness has generally not been clearly established. A physical modification that may hold particular promise for reducing the incidence of wildlife roadkill is use of a specialised roadside reflector, the Swareflex Wildlife Reflector (D. Swarovski & Co., Austria), which reflects headlights of vehicles into the adjoining terrain and can be detected by wildlife. Field trials overseas have however produced equivocal results, and a project in currently underway to assess the effectiveness of these reflectors in Australia (D. Croft, pers. comm.).

Visual shields that reduce disturbance of wildlife can be created using artificial structures or by making use of natural features. Hides (known in the USA as blinds) are used internationally for viewing of a range of birds and mammals (especially the former), and can comprise any physical structure that reduces the level of detection or disturbance to the animals being viewed. Although in many cases the primary aim of setting up such structures may be to enhance the visitor's experience, a secondary effect is that they reduce disruptions to the animal's activities and/or movements. Hides have been proposed as management measures to reduce disturbance of birds by tourists (e.g. Conder 1980, Anderson 1995). Viewing hides at waterholes in many Southern and Eastern African reserves enable the visitor to see a wider

range of large mammals at closer distances than would otherwise be possible. At the Chatfield State Park Wildlife Viewing Area (Colorado, USA), various natural and man-made structures are used at the viewing hide and on the approach route to break up the outline of people and so reduce the perceived threat posed to waterbirds by visitors (Larson 1995). At a nature reserve in Swaziland, visitors eat at a restaurant while viewing hippopotamuses in the adjacent waterhole through a window (pers. obs.). In Australia, hides are used relatively infrequently, but occur at a number of prime bird viewing locations, and are becoming more widespread. They are used only occasionally for mammal viewing, such as at Perup Forest Ecology Centre (WA) for viewing tammar wallabies, and at Canungra Valley Vineyards (QLD) for viewing platypus. Whether such structures are useful for reducing disturbance to Australian mammals has not yet been established. However we suggest that the presence of hides alone is not likely to be sufficient: visitors also need to be encouraged to approach and enter the hide as unobtrusively as possible and to refrain from loud talking or other potentially disturbing activities.

Various forms of technology can be used to allow visitors 'close-up' views of wildlife without approaching closely. The simplest example in wildlife tourism is the use of binoculars. More high-tech examples are the use of infra-red viewing equipment rather than spotlights for night viewing (as used by Wildscapes Safaris in North Queensland) and use of remote cameras at sensitive wildlife locations such as nests. One attraction that combines both these approaches is Naracoorte Caves (South Australia), where bats are observed in their breeding cave using remote infra-red cameras. Viewing occurs in a room away from the cave, avoiding any disturbance to the bats by visitors. A potential downside of such methods is that the equipment itself may inadvertently lead to an increase in negative effects – for example if a camera attached to a nest causes the bird to abandon the nest. Clearly such techniques should be applied with care and with knowledge of their likely effects.

Active Management of Wildlife or the Natural Environment
Deliberate habituation of wildlife involves gradually 'training' them to stop avoiding (and getting stressed by) the presence of visitors, and is routinely used by wildlife researchers conducting behavioural research on free-ranging animals. Normally, habituation involves repeatedly

approaching the animals to progressively closer distances over a period of weeks or months. Each time, the approach is curtailed as soon as the animals show behavioural signs of stress, but before they flee or show other avoidance responses. The observer then remains in place, behaving in a non-threatening way, for a period of time until the animal no longer shows signs of stress. For example, in the case of kangaroos, the animals should be approached to the point where one or more animals in the group adopt an alert posture, but before they flee. If the observer then stands or preferably sits quietly, the kangaroos will normally return to their previous activity. Although habituation normally occurs accidentally rather than deliberately, and is often principally aimed at enhancing the visitor experience, some wildlife tourism operators do make conscious efforts to habituate animals. A well-known example involves mountain gorillas, groups of which have been deliberately habituated to allow commercial tour groups to approach them closely (Butynski and Kalina 1998). In Australia, the operators and staff of Adventure Charter Tours on Kangaroo Island have successfully habituated western grey kangaroos and tammar wallabies to close approach in the middle of the day when they are resting in the shade. The animals are obviously aware of the human presence but have learned that there is no need to flee. However very little is known in a scientific sense about the most effective ways to habituate free-ranging animals, or to what extent it actually reduces negative effects of visitors on them. Given that effective habituation is likely to improve the quality of visitor experiences in many cases, and seems likely to have less potential for negative effects than hand feeding, such research would be valuable.

In captive environments where animals are handled by visitors, various restrictions can be used to manage the animals to limit their levels of stress (an animal welfare issue). Thus, in most Australian States visitors are not allowed to handle captive koalas, but can be photographed adjacent to them. In Queensland, where visitors are allowed to handle captive koalas, animals that are used for this purpose are conditioned to frequent handling by staff, and there are strict restrictions on the frequency and duration of handling by visitors.

In some cases where measures to stop tourists acting in ways that are detrimental to wildlife have failed, a last resort may be to train the animals to avoid the tourists. Conover (1999) showed that it is

possible to use aversive conditioning to teach free-ranging mute swans and Canada geese not to accept food handouts, although the conditioning was only partially effective. This experiment was conducted to investigate whether this method may be a viable way of avoiding the threats to humans and animals that can be caused through handfeeding. A similar method has also been used to discourage coyotes from raiding a campground (Cornell and Cornely 1979). At Fraser Island in Australia, where dingoes recently attacked and killed a child, rangers have used shooting with rat-shot to deter dingoes from approaching visitor areas (L. Fullarton, pers. comm.).

Techniques that may be used to rehabilitate habitats or wildlife are common to those used for conservation management in general. This might include removal of litter, clearing of weeds, replanting of native vegetation, reintroduction of logs, or even reintroduction of wildlife. At Phillip Island, artificial nest boxes have been provided to help compensate for past damage to little penguin burrows caused by uncontrolled trampling by tourists (R. Leivers, pers. comm.).

External regulation

A variety of regulatory mechanisms (based on legislation) are used by government to limit negative effects of visitors on the natural environment. Regulations are generally particularly stringent for protected areas. In many cases the law allows for prosecution of visitors and/or operators if the regulations are transgressed. Regulation has traditionally been the main approach used to manage impacts of nature-based tourism on the natural environment, and thus we cover this approach in some detail here.

Numbers of visitors to protected areas can be regulated through direct quota systems (maximum number of visitors allowed), and this happens occasionally in some overseas wildlife tourism destinations where visitor numbers have reached obviously critical levels (such as Galapagos National Park). More often in heavily used protected areas, numbers are controlled through indirect means (Buckley 1998a), such as requiring advance bookings, or limiting the length of stay and the amount of accommodation provided. For example the number of visitors to a bird sanctuary on Skomer Island in Wales is limited to 100 per day, the number that a daily ferry trip can carry (Wearing and Neil 1999). Alternatively the number of visitors can be controlled indirectly

through quotas on numbers of commercial operators, numbers of tours each can operate and/or size of groups they may take. In Australia, the use of permits (also known as licenses) for commercial operators in protected areas and State forests is standard practice. Permit conditions often state that certain activities and locations while be subject to a specified maximum group size (as well as a range of other conditions), although the details differ between different States and Territories. Conservation agency informants in this study reported that in general no limits were set on the numbers of visitors or operator permits in protected areas. However in some areas where there are high visitation levels and concerns about the sensitivity of the wildlife (or the natural environment more generally) to disturbance, such limits or quotas have been set. Specifically in relation to concerns about impacts on wildlife, limits on numbers of visitors have been set at Springbrook National Park (up to 500 visitors/night at glow-worm cave, although this figure is not based on any scientific research) and Macquarie Island (an arbitrary 500 visitor limit). A limit on the number of tour operators has been set for whale watching in Hervey Bay. Research is also underway to investigate whether and at what level a limit should be set on the number of dolphin watching boats in Port Phillip Bay, where community members and the tourism industry have raised concerned about impacts on the dolphins (B. Doolan, pers. comm.).

Spatial restrictions of one form or other are one of the most common management techniques to limit recreational disturbance (Knight and Temple 1995). Closures are a way of legally banning access to certain wildlife areas, and may be total or periodic. The latter are often seasonal, most often to coincide with sensitive stages of a species' life cycle, or applied according to perceived needs. For example spatial restrictions on activity close to bald eagle nests are varied depending on the time of year, which in turn relates to critical foraging and breeding periods that are thought to affect the birds' sensitivity to disturbance (Anthony *et al*. 1995). In Australia this approach is used with some critical bird breeding habitats, such as in the Coorong (SA). There are also certain reserves that are not open to visitors because of concerns about sensitivity of wildlife populations, such as Taunton Scientific Reserve, which contains the last remaining natural population of the endangered bridled nailtail wallaby (excluding recent reintroduction sites). Restrictions are also applied in relation to

seasonal variations relating to fire danger or other factors that might affect risks to wildlife and humans.

Zoning is a related approach to control the distribution of visitors according to judgements about the appropriate balance of preservation and use in different areas. It is very widely applied in protected areas around the world including Australia. Different zones in a national park, for example, typically cater for different levels of visitation and types of activities. In Australia these often include zoning of wilderness areas that are deliberately not developed for recreationists. Zoning can also be applied across whole regions according to assessment of conservation and tourism values (Dowling 1993). The Galapagos Islands archipelago is divided into five zones, only two of which admit tourists (De Groot 1983). The Great Barrier Reef has been divided into zones catering to conservation of biodiversity, scientific inquiry and various types of tourism.

Zoning regulations at the level of individual wildlife populations are also used for a number of wildlife species that are sensitive to recreational disturbance (Knight and Temple 1995). The size of these zones is often determined on the basis of distances at which responses considered to indicate detrimental effects occur – such as flushing or physiological changes. In the USA, such regulations have applied to bald eagles for many years, with certain restrictions on activities within 200 m of active nests, and even stricter restrictions within 100 m (Anthony *et al*. 1995). In Australia, comparable zoning regulations are applied to whale and dolphin watching. It is illegal for vessels to approach whales or dolphins within a distance of 100 m, and when within 300 m they must take various steps not to otherwise disturb the whale (e.g. *Environmental Protection and Biodiversity Conservation Act 1999* (Cwth), *Nature Conservation Act 1992* (QLD) and *Wildlife Conservation Act 1950* (WA)). One difficulty with such techniques is that the response distance often varies between sites and according to other variables, so it is difficult to set uniform guidelines (Anthony *et al*. 1995, Knight and Temple 1995).

A related strategy to control spatial distribution of visitors in relation to wildlife is the designation of refuges for species sensitive to disturbance by recreationists. Several permanent seasonal refuges have been created to protect the Florida manatee from collisions with

watercraft. Manatees have learnt to use these zones to avoid disturbance, and use them disproportionately when human activity levels are high (O'Shea 1995). In the United States, refuges have been established where game animals can retreat during the hunting season (Knight and Temple 1995). In Australia, refuges have been created to assist in conservation of dugongs, although this is not specifically related to tourism. There are also many marine areas where fishing is prohibited in order to protect areas of high conservation value. We are not aware of any refuges that have been created specifically to protect animals from wildlife viewing, although this may be one of several potential threats to certain species.

The principal method used by Australian government conservation agencies to regulate the behaviour of visitors and operators involved in commercial wildlife tourism in protected areas involves the use of commercial activities' permits. All commercial businesses operating in protected areas are required to have such a permit. These often include a requirement that operators ensure that their guests do not leave litter behind, do not feed wildlife, do not collect animal or plant specimens and stay on tracks (restrictions that also apply to independent visitors) and they often limit visits to daylight hours or particular days of the week. Specialised licensing systems supported by legislation also exist for certain forms of specialised wildlife viewing in Australia, such as whale and dolphin watching and swimming with whale sharks. These include details of how visitors or operators must behave in relation to wildlife, such as minimal distances from which they must be viewed and how long a boat may stay with an animal (e.g. Department of Environment, Queensland 1997, QPWS 1999b, ANZECC 2000, Environment Australia 2001, CALM *undated*).

Regulations directly restricting visitor behaviour and equipment are also often used. Slow speed zones were implemented as part of the apparently successful management strategy for reducing injuries and mortality of Florida manatees resulting from collisions with recreational and other watercraft (O'Shea 1995). On the Galapagos Islands, visitors must not wander off marked trails without permission, nor collect any biological specimens, leave litter, touch or feed animals (De Groot 1983). In Australian protected areas it is generally illegal to collect biological specimens (dead or alive), litter, feed animals, carry firearms or bring pets; and in some parks, visitors are not allowed to

use vehicles, even though there may be vehicle access tracks. Special legislation designed at least partly to reduce environmental impacts has been developed for certain sensitive areas (e.g. Shark Bay, Great Barrier Reef Marine Park) and certain species of particular concern. Once again, the most well-developed legislative restrictions on human behaviour are those developed for protecting whales and dolphins, as well as whale sharks in WA. As well as restrictions on approach distances detailed above, these specify constraints on other aspects of behaviour such as boat orientation and movement, noise levels, feeding and touching (e.g. Department of Environment, Queensland 1997, QPWS 1999b, ANZECC 2000, Environment Australia 2001).

Independently of regulations relating specifically to tourism or recreation, all States and Territories in Australia have legislation protecting wildlife (e.g. the *Threatened Species Conservation Act 1995* (NSW), the *Nature Conservation Act 1992* (QLD), the *Flora and Fauna Guarantee Act 1988* (VIC)). These Acts generally provide for prosecution if protected wildlife are collected or injured, or permitted to be killed or injured (e.g. by domestic animals), irrespective of whether this occurs in a protected area or not. Legislation relates only to those species that are listed as protected, which in most States includes most native mammals, birds, reptiles and amphibians. States differ as to whether and which fish and invertebrates are protected. Activities that involve direct contact with protected wildlife, such as trapping or handling, require a special permit, and are normally granted only if the activity forms part of a research or conservation program.

Strict restrictions are applied to hunting in most developed countries, typically including prohibition of hunting in national parks, limits on species and numbers of animals that can be killed, and time of year when hunting can occur. In Australia these restrictions apply only to protected species and exclude the introduced species that are most often involved in hunting. In some States, hunting of certain bird species (mainly waterfowl) is allowed under permit, but involves a short open season, an intensive licensing system, and strict limitations on the numbers and species that can be hunted. There are few restrictions on hunting of mammal or bird species that are not legally protected (mainly introduced species), although there are regulations relating to animal welfare standards (see below).

Most species of fish are not protected (unless they are considered under threat) and therefore can be caught without permits in fresh-water and marine habitats (outside of protected areas), although net-fishing is generally not allowed without a permit. Restrictions on fishing are generally less stringent than those for hunting terrestrial species (usually mammals and birds), but in some cases include use of closed areas, closed seasons, minimum sizes of fish to be caught, bag or boat limits on the number of fish caught, and restrictions on equipment to be used.

Most of the biodiversity within Australia, as for the rest of the world, comprises invertebrate animals, and it is well recognised that many thousands must have either become extinct or are in danger of becoming so (Yen and Butcher 1997). Invertebrates are however poorly represented in legislation, and in many cases not regarded as fauna unless they are included on a list of protected species. Most States allow invertebrates to be prescribed as protected wildlife, but collectively they list a little over 200 invertebrate species as protected species. This contrasts with German legislation which, in a much smaller and far less species-rich country, lists over 450 species of invertebrates as protected (*ibid*). The fisheries acts in WA and Queensland include crustaceans, molluscs and certain other aquatic invertebrates as 'fish'. The *Territory Parks and Wildlife Conservation Act 1988* was in review in 1997 (*ibid*), with proposed amendments which would require a permit for collecting non-marine invertebrates for commercial purposes. Yen and Butcher (1997) list 953 non-marine invertebrate species they consider to be of particular conservation significance, including: 464 insects (215 of which belong to one of the best-studied groups: butterflies and moths), 38 arachnids, 98 crustaceans and 324 molluscs. They state what should be obvious to conservation biologists but perhaps not to the general public: that the majority of endangered Australian fauna species are likely to be invertebrates, since invertebrates vastly outnumber the vertebrates in species diversity, but that we know far too little about them to prepare an adequate list. We suggest that protection of a greater number of invertebrates is desirable to help limit impacts of tourism and other activities.

Legislation relating to animal welfare issues is covered in the Prevention of Cruelty to Animals Act applying in each State or

Territory, and generally administered by the agricultural department. In most States this Act excludes fish and invertebrates. Codes of Practice relating to the welfare of animals – whether protected species or not – also apply in each State and Territory, but generally do not have regulatory status.

Regulations relating to feeding of wildlife constitute an area of controversy in Australia (Higginbottom *et al*. 2001a, Moscardo *et al*. 2001). There is little legislation specifically against feeding wildlife, even within protected areas. In Queensland, feeding native animals is illegal only (a) within a protected area if a regulatory notice prohibits feeding, (b) if the animal is considered 'dangerous, venomous or capable of injuring a person' (Nature Conservation Regulation 1994, Sections 87 and 237) or (c) in the Fraser Island Recreation Area (Fraser Island Recreation By-laws 1991, Section 237). The application of more generalised legislation to feeding is somewhat unclear. For example under Western Australian legislation (*Wildlife Conservation Act 1950*), 'taking' of wildlife is an offence, where taking is defined to include disturbing or molesting wildlife. Under Queensland legislation (*Nature Conservation Act 1992*) it is illegal to 'take, use, keep or interfere with a cultural or natural resource of a protected area'. In both cases it is not clear whether feeding should be included. Animal welfare legislation can however (in theory) be drawn upon if inappropriate foods are given.

Policies (whether official or not) concerning feeding of wildlife vary between States and reflect a level of confusion about whether it is practical and/or appropriate to prevent feeding. When asked about their agency's policy on hand-feeding three of the seven conservation agency informants said that feeding was 'not on' within protected areas. In some of the other States informants said that feeding of wildlife in protected areas was 'generally not allowed' but said that in practice the rules were more flexible if feeding was under restricted conditions, such as with use of appropriate food and provision of interpretation. A policy being developed by CALM (2000) in Western Australia proposes that feeding and watering of wildlife, when accompanied by appropriate interpretation, can be valuable in promoting a conservation ethic, and thus considers it to have a legitimate place at some sites in protected areas. It is proposed that such feeding should occur only under permit, and under strict

conditions such as use of suitable food, regulation of feeding activities and use of appropriate interpretation. For example, tammar wallabies at Perup Forest Ecology Centre are intermittently hand-fed by CALM staff to ensure appropriate type and quantity of food, and to attract wallabies for viewing by visitors. The draft policy also recommends that monitoring programs be implemented to assess the impacts of feeding on wildlife. Tasmanian Parks and Wildlife Service has an unofficial policy of 'keeping wildlife wild', which includes the principle that people should not feed wildlife (Parks and Wildlife Service, Tasmania, 1998). However in practice, views within the Service vary and rangers 'turn a blind eye' to feeding at some sites.

The lack of policy development relating to wildlife tourism is not restricted to feeding issues. Written policies covering management issues specific to wildlife tourism appear to be rare. Some of the few examples mentioned by conservation agency informants are draft policy guidelines being developed by CALM (2000) in Western Australia (including sections on how to manage wildlife feeding and wildlife spotlighting), whale-watching guidelines and regulations in Victoria, a draft Whale and Dolphin policy in Queensland, and a draft Dingo Management plan (for Fraser Island). Tasmanian National Parks have a set of guidelines for tour operators and tourists on seals, penguins, shearwaters, and wallabies, and are involved in further investigation involving these.

There are several examples of regulation to minimise animal welfare concerns where feeding does occur. The Moreton Bay Marine Park Permit Assessment (MBMPA 1997) regulates that fish must not be frozen for more than 12 weeks, must be thawed in non-saline water, and must not exceed 24kg at any one feeding. It also stipulates that individual adult dolphins (>10 years) receive no more than 3 kg per day, sub-adults no more than 2.5 kg, juveniles (< 4 years) no more than 2.4kg and infants prior to weaning age none at all (with care taken to avoid inadvertent access of provisioned fish by infants). All guests wishing to hand-feed dolphins at Tangalooma Wild Dolphin Resort are screened for signs of respiratory disorders, are required to wash their hands in anti-bacterial solution and must not deliberately touch the dolphins (Orams 1994 cited in Burger 1997). The Great Barrier Reef Marine Park Authority regulates the amount and type of food offered to fish on the Great Barrier Reef: fresh, raw marine

products or fish pellets, no more than 1kg per day, and no more than one feeding station per site (GBRMPA 2000).

Critical to effectiveness of all forms of regulation is a system for enforcement. This includes a surveillance component and some form of punishment. A system of progressively harsher punishment is most common, ranging from warnings to being banned from an area or fined, and possible imprisonment in extreme cases relating to killing of wildlife (Orams 1996).

Regulations are widely used in Australian protected areas as a means to limit effects of visitors on the natural environment (including wildlife). Anecdotal reports indicate that they are often at least partially effective for achieving their management goals, but there has been very little rigorous research to examine this. Responsible tour operators may actually welcome restrictions, as it helps to take away the competitive edge less responsible operators may otherwise have by cutting corners to the detriment of wildlife and the environment in general. Similarly there is evidence that some visitors welcome regulations to control their behaviour. In a study of people involved in viewing of bald eagle migrations, Frost and McCool (1998) found that 90% of those who were aware of regulations to control their behaviour believed that such regulations were necessary, and 32% stated that these restrictions actually enhanced their experience.

However there are a number of problems associated with use of regulations. Firstly, from the perspective of the tourism industry and visitors, they may restrict visitors from interacting with wildlife as they wish and consequently reduce their enjoyment (Orams 1996). A related problem is that regulations are often introduced in a reactive way once a management problem has occurred, and thus work against established patterns of visitor use. These problems not only potentially create negative reactions from visitors, but may also cause regulations to be disregarded.

There are many cases cited in the literature where tourists or operators do not comply with regulations. Aiello *et al*. (1999) report that nearly 60% of visitors to Green Island (Australia) broke environmental rules, especially regarding collection of shells and corals, and feeding of birds and fish. Despite the limit of 12,000

visitors per annum set for the Galapagos National Park, by 1989 there were 42,000 visitors (Wallace 1993). De Groot (1983) laments that 'in theory, Galapagos is one of the most strictly controlled National Parks in the world [and there are] many rules designed to minimise the disturbance … However … not all visitors will voluntarily submit themselves to all these regulations [and the] position of the guide is of crucial importance to the success'. The problem for the operator is illustrated by an example from East African safari tourism. Lubeck (1990) reports that 'Too often a tip on the side will influence where the vehicle goes.' He continues that 'Those [tourists] at the other table complain that they didn't see the cheetah and her babies because their driver refused to go off the road where all the other vans went'. Knight and Temple (1995) confirm that restricted access is often unpopular with recreationists and not easy to enforce. Many tourists feel that taking their once-in-a-lifetime opportunity to interact with or photograph a rare wildlife species outweighs any disturbance they might cause, and a high tourist-to-guide ratio makes it difficult to deal with such attitudes. Infringements of regulations have been documented in all programs involving tourist viewing of the endangered mountain gorillas. For example prescribed visitor group sizes and frequencies of visits have been exceeded, and visits to gorillas meant to be excluded from tourism have been made. There is evidence that tourism pressures could be sufficient to threaten the survival of these populations (Butynski and Kalina 1998). The problem essentially relates to the high demand for close-up encounters with gorillas combined with the strength of the profit motive for locals (*ibid*). Tour operators and tourists are often the instigators of these problems, pressurising and bribing guides and officials to allow extra visits when the normal quota is fully booked (McNeilage 1996).

Though the problems may not be as pronounced as in some overseas destinations, problems have been encountered in enforcing regulations on visitor behaviour in Australia, including situations relating to wildlife tourism. For example, some operators of glow-worm tours at Springbrook National Park are commonly in breach of permit conditions, such as exceeding the maximum allowed group size (R. Henderson, pers. comm.). In response to this problem, Queensland Parks and Wildlife Service have employed additional temporary rangers to try to enforce compliance. According to Alder and Haste (1995), a regulatory approach to management of the Cod

Hole, a popular site for recreational divers, fishers and tourist boats has failed to adequately protect the natural resources at the site. The above breaches of regulations occur in response to demand for viewing experiences exceeding the allowable supply. Resources available to protected area staff are usually insufficient for frequent checking that permit conditions are being fulfilled. Even if breaches of regulations are detected and can be proved, the level of fines may not be a sufficient deterrent.

In summary, regulation is widely used as a method of minimising impacts of visitors on wildlife and habitats, and apparently makes an important contribution to reduction of impacts. However it is not always effective. Some key factors that probably influence effectiveness are:

- Adequacy of scientific knowledge of relationships between components of visitor use and impacts on wildlife, which in turn can be used to inform education and create defensible regulations

- Level of understanding of and concern for the negative consequences of disregarding regulations by visitors

- Extent to which demand exceeds supply

- Effectiveness of enforcement and deterrents

Industry Self-Regulation

The concept of self-regulation by the tourism industry has become increasingly popular over recent years, largely in response to the perceived shortcomings of government regulation. Industry associations may act to foster high standards within their industry. This is seen as a way of raising the market profile of their sector and/or differentiating their members from non-member competitors in the marketplace. In many cases this may be enhanced by an intrinsic interest of members in high standards. This is arguably particularly likely in the case of organisations of nature-based tourism operators, for many of whom a love of nature is part of the motivation for what they do (Higginbottom *et al*. 2001a). The extent to which self-regulation by the tourism industry can effectively raise environmental

standards is yet to be properly tested, as such schemes are mainly in their infancy.

Organisations formed to promote and develop true 'ecotourism' – one criterion for which is environmentally sustainable practices – are likely to have a strong interest in seeing that their industry members adopt practices to minimise negative effects of their operations on wildlife. In Australia, the Ecotourism Association of Australia is the largest such organisation. It has introduced an accreditation scheme, now called the Nature and Ecotourism Accreditation Program (NEAPWG 2000), with a key goal being the raising of environmental standards by nature-based tourism operators. It is envisaged that NEAP accreditation will increase an operator's competitive advantage. To achieve accreditation, operators are required to meet a large number of criteria, some of which involve measures to reduce their negative effects on wildlife and to contribute to conservation. As of 2000, 176 operators have become accredited, and the Scheme has encouraged at least some of these operators to introduce new environmentally friendly practices (pers. comm. with three operators). This accreditation scheme is now being linked to preferential treatment with regard to access to protected areas, thus linking government and industry regulatory systems. The Scheme is also being extended to a system for accreditation of guides, aimed particularly at raising standards of interpretation (Newson 2000).

Industry associations may also introduce and disseminate codes of ethics or guidelines that promote sound environmental practices. The International Association of Antarctic Tour Operators have established codes of conduct for their membership that include measures to minimise negative impacts of wildlife tourism on wildlife (Giese 2000). The Ecotourism Society based in USA (now The International Ecotourism Society) has produced guidelines for nature tour operators (The Ecotourism Society 1993) designed to minimise negative effects of nature tourism on the natural environment, including wildlife (as well as promoting other aspects of sustainability). The American Society of Travel Agents has developed 'ten commandments on eco-tourism' (ASTA 2001) which include 'commandments' not to disturb animals and not to buy products from endangered animals. In Australia, the Tourism Council of Australia[1] and CRC for Sustainable

[1]A recently defunct organisation that was set up to represent Australian tourism operators

Tourism have jointly produced a best practice guide for tour operators which includes some basic recommendations about ways to minimise negative effects on wildlife (TCA/CRCST 1999). The checklist that comprises the core of the NEAP scheme (NEAPWG 2000) acts to some extent as an informal set of guidelines to which operators and managers refer.

Awards presented to organisations partly or wholly on the basis of high standards of environmental practices are another means of providing self-regulation of environmental standards. In Australia, various State and regional tourism agencies and conservation agencies offer Environmental Tourism Awards. Tourism businesses can also compete for other environmentally related awards such as The National Banksia Award for fauna conservation.

A major obstacle to the effectiveness of accreditation systems, awards or other labels to indicate that an operator is environmentally responsible is that they are likely to be effective only if they have a significant influence on consumer choice. This in turn depends on market recognition, and understanding and support for the idea among travel intermediaries. There are widespread concerns that currently the lack of market recognition of the NEAP program reduces its attractiveness to operators (Higginbottom *et al*. 2001a). Essential to market recognition is recognition of the importance of high environmental standards from travel intermediaries. According to Lubeck (1990), most safari-style tourism in East Africa is promoted through travel agencies who rarely promote 'low-impact tours'. There is thus a need for education of travel agents through tools such as positive publicity for operators adopting high environmental standards in travel trade magazines.

Economic instruments

The use of economic incentives and disincentives can be an important tool for managing the intensity of tourism activities (e.g. by limiting numbers of visitors or operators) and for promoting environmentally responsible behaviour by operators or visitors. Details of how these mechanisms operate are given in another report in the present series by Davis *et al*. (2000), and are thus dealt with only briefly here.

In terms of directly managing visitors, economic instruments act mainly through using the cost of activities to modify numbers and behaviour of visitors, or through imposition of fines as an economic disincentive for transgression of regulations. The presence and level of user fees and entry fees can be used to influence visitation levels (Vaske *et al*. 1995, Orams 1996). Whereas in the past, entrance to protected areas was often free of charge in more developed countries, entry fees are now common. Although the central intention of this is generally to raise revenue (Buckley 1998a), it may also have the effect of reducing visitor numbers.

There appears to be only limited use of economic instruments to facilitate sustainable management of natural resources in Australia at this stage (Davis *et al*. 2000). Orams (1996) suggests that there is considerable potential for greater use of such for managing impacts of wildlife tourism on the environment. He suggests, for example, that visitors could be offered discounts if they contribute to conservation-related work while on site, or that entrance fees could be adjusted according to the times that wildlife are most sensitive to disturbance. Davis *et al*. (2000) conclude that the potential role of economic instruments is poorly understood by management agencies and that there is considerable scope for wider application of such techniques to support environmental sustainability of natural resources used for tourism. It is clear that relying on economic market forces alone will not be sufficient to ensure sustainable management of natural resources (Caughley and Gunn 1996); economic instruments must be specifically designed by governments to support conservation objectives.

Education

Environmental education can in theory be used to cause voluntary changes in the attitudes and behaviour of tourists, operators and other members of the tourism industry. It can contribute to management of the environmental impacts of tourism through (a) influencing where visitors go, (b) informing visitors about appropriate behaviours, (c) developing visitor concern and/or (d) forming a component of substitute experiences (that do not entail visitors causing disturbance to the natural environment) (Moscardo 1998). Changes in the attitudes of tourists can potentially extend beyond the tourism experience in question to future actions that have

conservation outcomes, such as political support or personal involvement in conservation programs.

The term 'environmental education' is sometimes used to describe a relatively formalised educational activity, as distinct from environmental interpretation (e.g. Ham 1992). The latter has been defined as a form of communication which 'involves translating the technical language of a natural science or related field into terms and ideas that people who aren't scientists can readily understand' (Ham 1992), or which 'aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information' (Tilden 1957). Some authors have extended the definition of environmental interpretation to include the communication of messages about minimising negative impacts of the visitor on the natural environment (e.g. Orams 1996). Because of differing uses of the terms interpretation and education in the literature, 'environmental education' will be used broadly here to encompass all communicative activities designed to promote cognitive or behavioural changes in relation to issues pertaining to the natural environment. In the context of activities designed to promote environmentally responsible behaviour, it overlaps heavily with the concept of 'persuasive communication' (see Roggenbuck 1992).

There is widespread belief that most of the destructive behaviour of tourists comes from ignorance rather than malice (e.g. Lubeck 1990, Roggenbuck 1992, Ceballos-Lascurain 1996). In contrast to regulation, there is evidence that well-delivered education can enhance visitor satisfaction (Orams 1996). It is also reported that visitors to nature destinations are demanding an increasing amount of information, including that relating to what they can do for conservation (Roggenbuck 1992, Moscardo 1998). Thus many authors suggest that education is the most effective and yet most underused management technique (e.g. Buckley and Pannell 1990, Alcock 1991, Orams 1996, Wearing and Neil 1999).

There are a wide range of educational techniques that can be used by natural area managers to influence visitors (a user-friendly and detailed review of 25 such techniques is provided by Doucette and Cole 1993). Education is widely used in Australian protected areas to

try to promote minimal impact practices by visitors (some of which relate to effects on wildlife), demonstrating a belief in the effectiveness of this strategy by management agencies. Probably the most widespread tool used for this purpose in terrestrial protected areas in Australia is signage (at visitor information centres, information boards, and/or as stand-alone features). For example, they commonly have signs warning people not to feed wildlife, which usually also briefly explain why (e.g. Lamington National Park, QLD; Fraser Island World Heritage Area, QLD and Grampians National Park, VIC). At some larger parks, interpretative displays are provided, sometimes supported by face-to-face assistance. Some parks make written guidelines available that include requests not to interfere with wildlife (e.g. feeding or collecting). In some cases government interpretative staff at protected areas also help communicate a minimal impact message as part of their general activities or as formal guides. The extent to which ranger-guided activities are provided in protected areas varies between States according to policy and funding. In relation to wildlife tourism, such efforts are most pronounced at high profile wildlife attractions such as The Phillip Island Penguin Reserve, Mon Repos Turtle Rookery and Seal Bay. Guides at the latter two sites play a major role in making sure that visitors adhere to restrictions on their behaviour designed to protect the animals, while explaining the importance of such restrictions. Interpretative media at Seal Bay are generally designed to simultaneously enhance the visitor experience, increase appreciation of conservation, and encourage minimal impact behaviour (Oaten 1993).

The situation in marine protected areas is somewhat different from that on land or along the seashore. This is probably largely because a greater proportion of tourists participate in commercial tours and in larger groups than is the case in terrestrial protected areas, making it logistically easier to provide intensive interpretation. Further, the government authority responsible for managing the Great Barrier Reef (GBRMPA) invests a larger effort in education than do its terrestrial equivalents (Beckmann 1987). Heavy use is made of educational tools such as written guidelines and personal communication by guides, or by videos.

Opportunities for education about minimal impact behaviour at the sites of concern are likely to be maximised when visitors participate in guided tours. This of course requires that the guides are committed to

minimising their effects on the natural environment, and are able to communicate this message effectively to their guests. In practice, some guides apparently communicate such messages with passion and commitment, while others make no discernible effort to provide conservation-related messages (pers. obs.). However there has to our knowledge been no research to quantify the extent of different levels of such messages within the nature-based tour industry in Australia. Literature on the subject consists mainly of anecdotal reports of cases of apparently effective education. For example, Orams *et al*. (1996) reports that tourists at Tangalooma are told how to train the dolphins to behave passively rather than adopt 'pushy' behaviour. This intensive level of education is made possible by a ratio of one staff member to every 2-3 tourists in the water. However, serious concerns have been expressed by a number of stakeholders about the quantity and quality of interpretation in Australian wildlife tourism (Higginbottom *et al*. 2001a, Moscardo *et al*. 2001).

Some commercial operators also provide pre-tour information (including minimal impact messages) to guests. On their way to the Great Barrier Reef, passengers on Quicksilver Cruises receive a leaflet and view a video that includes advice on minimising impacts on the Reef (pers. obs.). Tourists onboard some ships travelling to the Antarctic are now shown a detailed video (Giese 2000) providing guidelines on how visitors should behave in the vicinity of penguins, along with information on the research that led to these guidelines (M. Giese, pers. comm.). This sort of information need not be restricted to providers of the environmental tourism experience: Lubeck (1990) states that British Airways and Lufthansa/Condor are showing short film clips on negative impacts of tourism.

In addition to education provided at individual locations or by individual operators, there are now a very wide range of written guidelines, training materials, codes of ethics and other documentation designed to reduce the impacts of nature-based tourism (Buckley 2001). These have been produced by governments, the tourism industry, environmental NGOs and other groups. The chief advantages of using written guidelines in comparison with other forms of education is that they are relatively cheap to produce and can be distributed in a wide range of forms (Ceballos-Lascurain 1996). These are not restricted to stand-alone guidelines issued to visitors

(before departure, during transportation, at accommodation or on site), but can be included in travel guide books, maps, in videos, or at visitor centres.

A number of written guidelines providing advice on appropriate visitor behaviour relating specifically to wildlife have been produced, particularly in North America. Some of these are generic to a range of species of wildlife, such as those presented in the wildlife viewing guides that are now available for more than half of the US States (as part of the National Watchable Wildlife Program 2001) and in guidelines produced by the National Audubon Society (1989). Codes of ethics to reduce impacts of wildlife tourism on East African wildlife in safari tourism have been distributed to travel agents in the US (Lubeck 1990). Other guidelines relate to particular species of concern, either because they are: threatened (e.g. bald eagles), potentially dangerous to humans (e.g. bears), or a frequent focus of tourism (e.g. whales). Examples of aspects that are commonly included are: general information about the species; minimum approach distances; avoidance of feeding, touching and removal of animals; maximum group sizes; maximum durations of visits; guidelines about noise levels and types of movement, and behavioural restrictions relating to minimising impacts on habitat.

In Australia, we are beginning to see guidelines relating to impacts of tourism on wildlife being produced. The Nature and Ecotourism Accreditation Program involves a set of assessment criteria that function as *de facto* guidelines (NEAPWG 2000). General criteria that relate to wildlife disturbance include specifications that operations do not involve intrusion into wildlife habitat which causes significant disruption to certain aspects of their behaviour, and that they do not corner, chase or harass wildlife. There are also criteria applicable to particular types of wildlife tourism. One set of criteria deals with viewing of marine mammals and other megafauna, with criteria such as: 'vessels are not positioned directly in the path of animals and do not chase or herd animals'. Another deals with nocturnal viewing of animals, including spotlighting (e.g. 'red filters are placed in front of spotlights once an animal has been located'), turtle viewing (e.g. 'turtles leaving the water or moving up the beach are not approached'), and glow-worm viewing (e.g. 'lights are not shone directly on the glow-worms at any time'). The recently published

Lonely Planet guide to watching wildlife in Australia (Bennett *et al*. 2000) is likely to be widely read by international visitors, and mentions some steps that should be taken to minimise negative effects of viewing on the wildlife. It provides a general statement about the need to avoid disturbing wildlife, and very brief tips on minimal impact practices such as how to get close to wildlife and how to use spotlights without disturbing animals. The Great Barrier Reef Marine Park Authority has a relatively detailed set of recommended 'best environmental practices' available to visitors which are designed to minimise their negative effects on the natural environment. These include guidelines relating specifically to fish feeding, fishing, whale and dolphin watching, diving and snorkelling, reef walking, turtle watching and observing seabirds (GBRMPA 2000). Some further individual species or taxa for which written guidelines are available are: dingoes at Fraser Island (QPWS 1999c), sea lions (NPWSA 2001a, CALM 1992), little penguins (NPWSA 2001b, Tasmanian Parks and Wildlife Service *undated*), cetaceans (e.g. QPWS 1999b, DENRSA 2000, CALM 2001), whale sharks (CALM *undated*) and albatrosses (Tasmanian Parks and Wildlife Service, 1996). A video is available for visitors to the Antarctic providing detailed guidelines on how to minimise impacts on Adelie penguins (Giese 2000).

Education need not be restricted to visitors. At the Galapagos Islands, the National Parks Service and the Research Station run intensive courses for operators, which are pre-conditions for obtaining licenses. These emphasise special qualities of the Galapagos environment and the reasons for the strict regulations (De Groot 1983). Similarly the regulatory authority and a number of commercial tour companies operating in the Great Barrier Reef Marine Park provide guides with formal training in interpretation (including desirable minimal impact behaviour) (Crabtree 1995, Aiello 1998). The government authorities that run Seal Bay and Mon Repos provide written training guidelines for their guides, which include advice on minimal impact behaviour and how to maintain this among their visitors. Since behaviour is influenced partly by expectations, it may also be important to educate others involved in the tourism industry, such as travel agents.

Education also extends to informal and formal communication processes set up for interaction between management authorities and the tourism industry. The following mechanisms are seen by the Great

Barrier Reef Marine Park Authority as critical for education purposes within the Park:

- establishment of representative advisory groups;
- liaison meetings with public lobby groups;
- publicity and public relations;
- face-to-face talks at local meetings; and
- representation on management committees (Alcock 1991).

Education need not be directly focused on teaching minimal impact behaviour (especially as tourists are on holiday and do not wish to be continually lectured to or reminded of the world's problems). Simply finding out that certain species exist, or about their habits, may allow visitors to realise what impacts their behaviour might have on those species. In Australia, these might be particularly applicable given the large number of cryptic, small and nocturnal species (see Green *et al*. 2001). For example, knowing that fallen logs may be dwellings for a number of small marsupial and reptile species might make people less likely to chop up those logs for firewood.

In cases where enforcement of regulations is not practicable, education may be the only practical alternative. CALM (WA) recognises that visitors will continue to feed bettongs in Perup Forest Ecology Centre and Dryandra Woodland and other such reserves, but advise them to use appropriate food (nuts and seeds to emulate the oily diet of the local bettongs) (Moncrieff 1995).

There have been relatively few studies of the effectiveness of different educational techniques for managing impacts of visitors on wildlife, although there is a substantial body of literature relating to use of education in natural area management more generally (though very little for Australia). However, much of what has been written about principles for designing effective educational experiences in relation to nature-based tourism and recreation is based on opinions rather than empirical research (Doucette and Cole 1993, Orams 1996, Broad and Weiler 1998, Moscardo *et al*. 2001).

One of the most comprehensive studies to have examined opinions about the effectiveness of education as a visitor management technique was conducted by Doucette and Cole (1993). The study involved distribution of questionnaires to a large proportion of terrestrial protected area managers in the United States, and achieved a 54% response rate. Managers rated educational techniques (as implemented) as only moderately effective in dealing with management problems. Roggenbuck (1992) reports that opinions on the effectiveness of educational programs for visitor management in natural areas in the US vary between agencies and according to the nature of the problem behaviour. As reported in section 3.1.2., most of the key informants interviewed for the present study felt that the potential effects of education within wildlife tourism were so positive that they produced a net conservation benefit from wildlife tourism.

Roggenbuck (1992) reviews findings of systematic evaluations of the effectiveness of education in managing visitor behaviour in relation to natural resource management. He reports the following key conclusions:

- Education is often effective in increasing knowledge, favourable attitudes and positive behavioural intentions about rules.

- Education is often effective in altering the places that recreationists visit.

- Education often prompts a reduction in environmentally destructive practices, at least in the short term .

Systematic evaluations of the effectiveness of education within wildlife tourism are restricted mainly to zoos, but these typically study outcomes such as enjoyment and ability to attract attention, rather than learning (Woods 1998). They do however elucidate useful principles for zoo managers to follow in designing educational initiatives (see Woods 1998 for a review of these).

In relation to the use of education in managing impacts of nature-based recreation on free-ranging wildlife, very little empirical research has been conducted, although we would expect that findings reviewed above in relation to impacts on the natural environment in

general would apply. There is abundant circumstantial and anecdotal evidence that at least some education programs are highly effective in managing visitor behaviour in relation to wildlife. A frequently quoted example is the program initiated to reduce collisions with Florida manatees (e.g. Ceballos-Lascurain 1996, Shackley 1992). This included the issuing of hundreds of thousands of brochures (containing guidelines) and maps of manatee speed zones, manatee awareness workshops, formation of a 'Save-the-Manatee Club' and large amounts of media coverage. In association with regulatory measures, this program appeared to lead to a substantial reduction in manatee mortality (O'Shea 1995) (however see section 3.3.1 for a cautionary note). Another example of the apparent effectiveness of education in managing impacts of visitors on free-ranging wildlife is cited by Harris *et al*. (1995). They found that more than half of trail visitors interviewed in national parks in southern Arizona said they would be willing to give up their wilderness activities if they were reliably informed that this was necessary for the long-term persistence of bighorn sheep. In Australian wildlife tourism, education programs at Seal Bay are reported to have been effective in managing visitor behaviour in relation to sea lions (Oaten 1993). Tony Lee (pers. comm.) states that although participants in his company's tours are initially disappointed when they discover they will not be allowed to handle koalas, this disappointment dissipates when the rationale is explained. Such examples rarely allow us to confidently conclude a strong cause-effect relationship between education and reduced negative impacts of visitors on wildlife. In the case of the Florida manatee, for example, the amount of resources put into this program have been exceptionally high (and therefore the case may be far from typical), and it is still not entirely clear whether factors other than deliberate management strategies might have contributed to the reduced mortality (O'Shea 1995).

Research indicates that the technique used to deliver education is critical to the extent of learning that occurs (Broad and Weiler 1998, Moscardo 1998). There is a wealth of general educational and psychological theory and experience to draw on to assist with such decisions. Some of the key principles are reviewed by Moscardo (1998) for tourism in general, by Doucette and Cole (1993) for wilderness management, and by Broad and Weiler (1998) and Woods (1998) for zoos. One of the most critical principles is that to facilitate

a change in visitor behaviour, something more than delivery of information and appeal to the cognitive domain is needed (Broad and Weiler 1998). In the case of promoting minimal impact behaviour, additional measures might involve negative reinforcement of inappropriate behaviour (such as fines) or an appeal to the affective domain (such as through encouraging emotional concern for the animals that management aims to protect). Because the process of learning is so complex, what works best will often vary depending on the specific situation and the individual concerned (Broad and Weiler 1998, Woods 1998). In particular, visitors who already have high levels of knowledge are less likely to respond to persuasive messages (Roggenbuck 1992). Reviewing systematic evaluations of educational tools used in natural resource management, Roggenbuck (1992) found that signs are often one of the least effective methods, and that use of multiple media is generally more effective than use of a single media.

One of the most widely held beliefs held by protected area managers in this context is that delivery of personal interpretation from a guide is the most effective method of education for nature-based tourism (Roggenbuck 1992, Doucette and Cole 1993, Broad and Weiler 1998, Aiello 1998). Similarly Davies (1990) reports that the Royal Society for the Protection of Birds (UK) believes that face-to-face interpretation is the most effective educational method, and have consequently employed increasing numbers of information wardens to provide education relating to wildlife and its management. However Roggenbuck's (1992) review concluded that personally delivered education is 'often' no more effective than non-personal methods. Clearly this is an important area for further research and clarification.

Even if education is an important tool for managing visitor behaviour, it is clear from research and experience that there are constraints on its effectiveness. In addition to factors mentioned above, these may relate to deep-seated emotional needs such as the desire to hand-feed or competition from self-interest in the case of some tourism operators. Lubeck (1990), in discussing East African safari tourism, remarks that 'the mainstream, or packaged tour industry, is made up of tourists who may or may not have any previous environmental orientation. Imagine that they are now being coaxed to adopt more ethical behaviour in the midst of their grand and carefree holiday. The

question is how to encourage travellers and tour companies to adhere to the rules of the wildlife reserve and to enhance their awareness and spirit of cooperation in a way that doesn't equate to an assault on their rightful pursuit of adventure and pleasure.' The difficulties of designing an effective educational program for wildlife include diverse characteristics of visitor groups, the fact that viewing sites are often widely dispersed, lack of adequate knowledge or suitably skilled staff (Orams 1996).

It seems likely from the above review that well-conducted and appropriate education can be a powerful tool for minimising negative effects of people on wildlife (and indeed in contributing to positive effects). However far too little is currently known about what approaches work best in specific situations – especially for those that are specific to wildlife tourism. Clearly, there is a need for research to evaluate the effectiveness of various forms of education in encouraging sustainable visitor behaviour (Moscardo *et al*. 2001).

Marketing

Conducting market research can be used not only to try to match products to market demand, but can be an important way of understanding expectations and attitudes that have implications for managing impacts of visitors on the natural environment. For example Vaske *et al*. (1995) report on the use of visitor surveys to assess beliefs that might influence the effectiveness of management strategies, and thus facilitate the appropriate design of educational programs to help develop beliefs considered to be appropriate. Similarly Roggenbuck (1992) states that information on market segmentation enables park managers to decide where and how to target their minimal impact educational initiatives.

The level of public interest and subsequent visitation levels to a site can be strongly influenced by the amount, effectiveness and dissemination of advertising and promotion. Thus marketing can be used to indirectly influence visitor numbers. For example, protected area management agencies often deliberately avoid promoting areas with wildlife populations that are sensitive to disturbance. This is the case, for example, in relation to a glow-worm colony on Tamborine Mountain, Queensland (W. Buch, pers.comm.).

Education in the broadest sense includes messages communicated through advertising and promotion, which may have strong roles in influencing expectations and behaviour. Frost (1999) describes photos on advertising brochures that show environmentally inappropriate behaviour, such as a diver patting a large fish while diving on the Great Barrier Reef, or a group of people standing next to a seal at Seal Bay, Kangaroo Island. He also mentions a brochure photo which shows the 'penguin parade' at Phillip Island with no hint of the stands and fences used to control visitor access. He concludes that such brochures could encourage inappropriate behaviour, whereas with some careful thought they could instead become powerful management tools. Other examples from the authors' collection of current brochures for wildlife tourism in Australia that may encourage inappropriate behaviour include photographs of: parrots being fed bread, a starfish being removed from the water, and cuddling of koalas. Examples from this collection that may help to promote more environmentally appropriate behaviour are: people observing birds through a telescope from the roadside, a small group of visitors crouching some distance away from a turtle returning to the sea, and visitors walking on boardwalks. When marketing materials are produced by governments, this provides the advantage that minimal impact guidelines can readily be incorporated. For example the South Australian Tourism Commission's (1998) visitor guide to Kangaroo Island includes a 'Wildlife Viewer's and Photographer's Code'.

Use of environmentally responsible operators and guides
By encouraging and supporting appropriate volunteers and commercial operators to provide guided wildlife tourism activities, resource management authorities can indirectly enhance levels of environmental education and control of visitor behaviour. In many Australian protected areas, volunteers are encouraged and supported by management agencies in assisting with conservation and education work. Current moves in Australia to link NEAP accreditation of operators to preferential terms for use of protected areas are a step in this direction (Protected Area Managers Workshop, Ecotourism Association of Australia 2000).

Encouraging or enforcing use of guides by visitors is a common measure designed to minimise negative effects on wildlife. At Galapagos National Park, it is compulsory for visitors to be

accompanied by a (certified) guide (De Groot 1983). Similarly at the major government-run wildlife attractions at Seal Bay (J. Crocker, pers. comm.) and Mon Repos (QPWS 1997), visitors are allowed into the colonies only with a guide (who generally works for the conservation agency concerned).

Cooperative agreements
Outside the system of regulatory arrangements, environmental management agencies may enter into cooperative arrangements with individual private tourism operators regarding use and management of natural resources including wildlife. This might include various conditions such as practices that the operator must carry out to ensure that wildlife are protected or even that they contribute to monitoring or habitat restoration. We are not aware of any such arrangements pertaining specifically to wildlife tourism in Australia. However, formal cooperative agreements exist with the two nature-based lodges in Lamington National Park, which include operators assisting with managing the impacts of nature-based tourism (e.g. track maintenance, weed control, assistance with fire management) in lieu of paying permit fees (R. Henderson, pers. comm.).

Relative effectiveness of different visitor management techniques
Case studies illustrate that all the above techniques can assist in reducing negative effects of visitors on the environment in some situations (e.g. see Knight and Gutzwiller 1995). Traditionally, external manipulation through physical alterations and government regulation have dominated management approaches for most tourist-wildlife interactions (Orams 1996), while there now appears to be a shift of support among researchers and governments towards industry self-regulation and use of education.

Given the wealth of collective experience, it should be possible to draw some conclusions about what approach, or combinations of approaches, work best in particular types of situations. However, although many authors comment about the effectiveness of certain techniques (e.g. Cole *et al*. 1987), there has been little research to compare their relative effectiveness. One exception is a study by Hall and McArthur (1998), who conducted a qualitative assessment of different visitor management techniques (using a different but comparable typology to the one given here) based on a wide range of

case studies. They judged that all techniques performed at least reasonably in terms of achieving conservation objectives (Hall and McArthur 1998), with the best performers being: regulation of access, use of marketing and education, and using volunteers or accredited tour operators. However, visitor management often aims not only to minimise negative impacts on the natural environment, but also to improve the quality of the visitor experience (McArthur 2000). The techniques that were judged to perform well in terms of both criteria were marketing, education and use of volunteers or accredited tour operators. These options were also judged to perform well in terms of creating support for forest management. Unfortunately the assessment method used in this study was specified as 'qualitative assessment', without clarification of the methods used.

While it is not possible to be prescriptive about exactly which technique should be used when, some factors that should be considered in making the choice can be identified:

- Level of understanding and concern for the management problem by the public: a regulatory approach is much more likely to succeed if visitors understand and support the need for restrictions; conversely if they do not then education may become critical.

- The magnitude of potentially negative effects that are considered acceptable: in the case of an endangered species at a sensitive stage of its life cycle it may be critical to ensure no tourist access occurs at all and therefore a strong regulatory approach may be needed.

- Spatial scale: if a sensitive wildlife population is restricted to a small area, then engineering works and provision of interpretive guides in that area may be feasible, but costs may preclude such an approach if the wildlife is more dispersed.

- Cost: in practice, this is likely to be a key factor influencing type and extent of management measures. However, if costs of adequate management to protect the wildlife resource are prohibitive, then the cheaper option of preventing all access should be preferred.

- Availability of labour and expertise: this is linked mainly to cost over the long term, but in the short term lack of staff or operators to provide skilled education could be an obstacle to this approach.

Further, in choosing appropriate management strategies for a particular situation, Vaske *et al*. (1995) recommend that each strategy be assessed according to: consistency with management objectives, ease of implementation, effects on visitor freedom (the assumption being that this should be maximised where possible), probability of achieving desired outcome in relation to environmental impact indicators, and effects on other impact indicators; and then compared using a matrix approach. However this will often still leave the difficulty that there is inadequate knowledge of the effectiveness of different techniques, particularly in terms of environmental impacts.

A management strategy should ideally consist of a number of mutually supporting or complementary approaches. In particular, supporting regulation with appropriate education is often likely to be important. Banning access from one site will not be helpful unless visitors are provided with what they desire at another site, or unless their expectations are modified (McArthur 2000). Industry self-regulation and government regulation can also be complementary. For example Lubeck (1990) suggests that 'Passengers may be less inclined to pressure the driver to bend rules if he displays an 'it's against the law to harass wildlife' sticker next to his award for being 'Driver of the Month''. Davis *et al*. (2000) concludes that combining use of regulation and economic instruments is advisable. Managers need to consider the merits of each different technique for their particular situation, and design a package of complementary options.

4.3 Monitoring

4.3.1 Introduction

Environmental monitoring is 'a process of repetitive observation of one or more elements or indicators of the environment according to pre-arranged schedules in time or space' (Selman 1992). It is critical to the sustainability of wildlife tourism. Without some kind of monitoring system, there is no way of assessing the effects of tourism

activities other than those that are very obvious. Even the best human memories have their limitations when trying to recall previous situations and changes over the years without written or electronic records. Whereas some effects on the natural environment are visually obvious and it could be argued do not require scientific monitoring (such as destruction of vegetation, erosion and severe trampling), effects on wildlife are often difficult to detect without specific attempts to measure them and may be more difficult to reverse.

Monitoring may be undertaken by government conservation departments (especially if the tourism occurs within protected areas), by tourism operators or their staff (usually on a necessarily smaller scale), by consultants employed by either of these groups. It may also be conducted by researchers as part of a general study on the effects of tourism.

A good monitoring program has the potential to:

- inform the tourism operator of local changes which may need action for the continued success of the operation;

- identify local changes that may indicate a more general conservation problem; and

- collectively with results from other operators and researchers, to seek further understanding of potential conservation problems that may arise as a result of various wildlife tourism activities, and the effectiveness of attempts to ameliorate these.

There are two critical questions in designing a suitable monitoring program: what sampling design should be used (how to monitor), and what indicators of effects on the wildlife should be used (what to monitor). The 'how' question (apart from detailed techniques of measurement and observation in various situations) is mostly generic to monitoring the effects of any human development or activity on the natural environment. It requires consideration of scientific principles applicable to monitoring, as well as how (and to what extent) these can applied in practice. The 'what' question raises some issues that are particular to wildlife, and also to wildlife tourism.

4.3.2 How to monitor

Much has been written about how environmental monitoring should be conducted from a scientific perspective (e.g. Green 1979, Bernstein and Zalinski 1983, Underwood 1989, Fairweather 1991, Underwood 1994) and a full review of this topic is outside the scope of this report. Adoption of these scientific principles is necessary if managers are to be confident that the results of monitoring are valid. Here we briefly review some of the key issues that should be considered in designing a monitoring program, and some of the key constraints and dilemmas these raise. Monitoring typically involves repeated measurement of the same quantitative parameters over time, to determine the existence and magnitude of any changes. Operators who feel a bit over-whelmed by the requirements for a full scientifically-valid study should not give up on the idea of monitoring, as there is useful information that can be gathered on a smaller scale for particular purposes (see below). They do however need to be aware of the limitations of their monitoring programs, avoid the temptation to over-generalise, and be alert to possibilities for improving the quality of information collected.

If a monitoring program is to reliably detect environmental changes that are due to the effects of tourism, managers need to be reasonably confident that:

- any changes detected are valid, rather than the result of biases or other errors in the sampling design;
- the program is able to detect changes of sufficiently small magnitude to fulfil requirements determined by management objectives (sufficient 'power' of the analysis); and
- any changes detected are due to the tourism activity rather than other factors.

To achieve these requirements, experimental design and statistical considerations common to all ecological research need to be applied. In order to avoid bias, standardised sampling methods are needed on each sampling occasion (see Williams 1995 for further explanation). For example in the case of spotlighting censuses, if observers of

differing levels of experience are used at different times, then differences in numbers of animals detected might reflect differing experience rather than real differences in animal densities. Similarly if sampling occurs under different moon phases, then different numbers of arboreal mammals may be observed in response to moon phase rather than because of differences in densities. Carefully defined protocols are needed to ensure that the methods used are virtually identical on all occasions, and where necessary these should be supported by training.

In order to be confident that any changes detected are indeed due to tourism, a monitoring program should ideally involve:

- use of control (as well as tourism) sites: to control for effects that are not related to tourism;

- replication of control sites, and also of development sites if possible (the latter is feasible if the concern relates to a number of similar tourism operations): to ensure that the effect is not due to peculiar circumstances occurring at the sites in question (such as the temporary drying up of a water-hole, or flowering trees nearby attracting birds and bats away from the immediate area);

- repeated sampling over appropriate time intervals: to avoid confounding with the effects of natural temporal variations (e.g. weather changes, bird migrations); and

- sampling for baseline data prior to the development: to determine the magnitude of effects specifically due to tourism.

Ideally, to achieve sufficient statistical power to detect a change (the probability of finding a statistically significant change when there is a real change present), there should be:

- sufficient numbers of replicate sites;

- sufficiently 'precise' estimates of the monitored parameters (see below); and

- sufficiently low levels of variation in parameters due to factors that are not related to tourism but vary with time.

Numbers of control sites and replications needed will depend largely on the amount of spatial and temporal variability in the measured parameters, and should be determined by pilot sampling for each case. Numbers will however often be constrained by logistics.

Research has shown that environmental impact assessment and monitoring studies for Australian tourism developments rarely satisfy all or even most of these criteria (Warnken and Buckley 2000), and that lack of sufficient power is a widespread problem with environmental monitoring (Buckley 1991a). We propose that this is due to four main factors:

1. inherent difficulties in sampling many environmental variables;

2. inadequate knowledge of, or ability to apply, these principles by managers;

3. lack of motivation by many private operators to carry out extensive environmental monitoring; and

4. the substantial resources needed to carry out a scientifically valid monitoring program.

These last three factors are explored further in section 4.6.

Inherent difficulties with sampling are particularly marked for biological parameters (including wild animal populations) and relate principally to:

- typically high levels of natural variation in environmental variables across time and space (Underwood 1994);

- practical constraints on sampling techniques;

- difficulty in finding suitable control sites ;

- substantial time lags between the tourism event and environmental responses (cf Underwood 1989); and

- high numbers of co-existing species that may affect one another (e.g. through predation, competition or mutualisms).

High levels of natural variation in biological parameters are a major cause of typically low levels of precision in estimates of biological parameters. Every quantitative estimate is associated with a measure of variation, often expressed as a standard error or a confidence interval. If the variation around an estimate is large in relation to the amount of change that is of concern, then it will not be possible to detect whether a change of that magnitude has occurred. Alternatively expressed, for any monitoring program there is minimum level of change that will be detectable. To maximise precision (and thus minimise the level of change that can be detected), a large sampling effort may be required which takes into account spatial and temporal variation. However, for some species or parameters the amount of sampling variation will be so large that the amount of sampling effort required to obtain a reasonably precise estimate is prohibitive. For example, Marsh (1995) has estimated that for dugongs the minimum detectable rate of decline based on ten consecutive annual surveys is 8.1% per year (given the commonly used alpha level of 0.05). By this time the population would have declined to 47% of its previous levels! These sorts of problems are likely to be most prevalent for species that are long lived, have delayed onset of age at first breeding and produce small numbers of young. This has several implications:

- Where possible, species and parameters should be selected for which adequate levels of precision can be achieved.

- Power analyses and/or calculation of the minimum detectable level of change should be conducted (based on a pilot study to determine the amount of variation in the parameter of interest) before deciding whether to go ahead with a certain monitoring approach and/or how much sampling effort is required (Green 1989, Fairweather 1991). Specifically, Bernstein and Zalinski (1983) recommend that a monitoring program should be

designed to have a specified probability of detecting a predicted change of a specified magnitude.

- If a desirable level of precision cannot be achieved, it may still be worthwhile to proceed with monitoring, but there must be awareness that a high level of uncertainty exists over estimates and that statistical analysis may not be worthwhile.

Practical constraints on sampling techniques can lead to biases and/or imprecise estimates, and again this is a particularly common problem for parameters relating to wildlife. Some common problems relating to determining abundance of wild animals are: difficulties in finding the animals; difficulties in accurately identifying species; susceptibility of census techniques to bias according to habitat type (e.g. animals are often easier to observe in the more open habitats); and lack of research on accuracy and precision associated with different techniques. For example, the main method used to assess the abundance of Australian possums is to use spotlight counts. Because of relatively low densities and because many animals are not detected because they are hidden in vegetation, it will take many hours of spotlighting to detect reasonable numbers of animals. Some animals may be partially obscured by vegetation such that only highly skilled observers can be confident of accurate species identification. Because detectability varies according to vegetation type and type of path followed by the observer (e.g. road vs. narrow track vs. cross-country), biases may occur in sampling if these factors are not carefully incorporated into the sampling design.

Lack of availability of suitable control sites is a common problem. This relates to the high degree of spatial heterogeneity usually found in the natural environment, and the multitude of different anthropogenic influences that apply at different sites. This is hardly surprising: the very occurrence of a wildlife tourism activity at a particular site is often due to the unusual natural features of that site, which may also make it of high quality for the species involved in wildlife tourism. This problem can be partially addressed by instead using 'reference sites', which while they differ in a number of ways from experimental sites can still be used to qualitatively indicate effects of major extraneous variables such as drought.

Substantial time lags between tourism events and environmental responses are common (Buckley 2000). This is a particular problem in terms of responses of wildlife at the population level, especially among long-lived vertebrate species (e.g. dugongs, whales, turtles, cockatoos). Without adequate consideration of time lag effects, those involved in monitoring might wrongly conclude that tourism has had no detrimental effects (Gutzwiller 1991). For example, aging individuals might be repeatedly observed although younger animals are failing to survive or moving elsewhere. Other effects may be occurring at such low rates that many years are needed to measure the changes (see the albatross example by Higham 1998, noted in 3.2.4). This is of serious concern if it is too late to reverse the trend by the time a change is detected. The consequences of this are two-fold:

1. monitoring should be in place for long enough to allow for time lags;

2. in the case of species for which long time-lags are expected before population-level effects are apparent, more proximate indicators of potential detrimental effects – such as behavioural changes – are desirable.

Interactions between species may obscure the mechanism of the effect of tourist activities on wildlife. If it is noted for instance that a particular bird species is declining it may be concluded that it is sensitive to human activity. The real problem may be however that one of its competitors is feeding on picnic scraps, increasing in abundance and usurping its nesting hollows. Such indirect effects could also occur through disruptions to mutualisms, depletion of prey species or food plants, increase in accessibility of the area to predators, or the introduction of parasites or pathogens on hikers' boots or campground litter. Such interactions also add substantially to the problems of natural variation and time lags outlined above.

Two main types of study designs are recommended. The first is to use a factorial analysis of variance design to test for a significant interaction between site (experimental vs. control) and time (before vs. after, or several time intervals). In this case, to meet statistical requirements for independence of samples, monitoring should occur at different spatial locations on each sampling occasion and aim to

obtain data on different animals. The second design involves use of experimental sites only, with repeated measures over time at the same locations. Depending on the spread of the data across time, this can then be analysed using either a time series analysis or a repeated measures analysis of variance.

Although the above approaches are desirable in order to draw firm conclusions about the environmental impacts of tourism, criticisms in the scientific literature of prevalent monitoring practices may not be fully justified. The objective of management is often to detect any detrimental changes (no matter what the cause), while scientists generally wish to determine strict cause-effect relationships. Given limited resources, it may frequently be more cost effective to dispense with the ideal of monitoring control sites and pre-development conditions, and to target resources to monitoring tourism sites and then determining the cause of any detrimental changes that may be detected. If repeated sampling over time is not possible, but suitable control sites are available, then occasional comparisons between tourism and control sites may be sufficient to determine whether tourism is having detrimental effects (for example if nocturnal animals are using control areas far more than regular spot-lighting areas). Nevertheless the issues raised above relating to power to detect real changes that are occurring remain vital to our understanding of effects of tourism on wildlife. There seems to be a need for greater collaboration between managers and scientists to determine valid yet realistic monitoring protocols under various different conditions.

Ideally monitoring should be conducted at a number of spatial scales. Monitoring of individual tourism developments or activities should occur where these are on a sufficient scale to raise concerns about detrimental effects. Where many activities of a similar type occur within one area (leading to potential cumulative effects), such as wildlife tours in different parts of a national park, there are opportunities for monitoring replicate impact sites, and a coordinated monitoring program should be undertaken. Where activities are spatially distinct but of similar types (e.g. whale watching tours in different parts of Australia) there are also opportunities for coordination of replicated monitoring efforts.

4.3.3 What to monitor

Since it is never possible to measure all potential effects on all species, a critical choice is which species and attributes of those species to monitor. Sometimes measurements are made directly of the issue in question (for instance estimates of the local abundance of an animal popular with tourists), but on many occasions variables known as 'indicators' are employed. These indicators may include another aspect of the species in question (for instance changes in its behaviour may indicate that all is not well and a population decline may be expected) or habitat features. Alternatively they may involve assessment of the abundance of a selected suite of species to reflect changes in wildlife generally. The rationale for the latter possibility is that a change in the abundance, frequency or condition of some species may reflect a change in other species with similar needs (e.g. hollows for nesting, shrubby understorey, fruiting trees), interacting species (food-chains, mutualisms) or the ecosystem as a whole. Even those who do not think of themselves as using indicator species are in effect doing so if their goal is to assess biodiversity, the normal functioning of an ecosystem, or 'environmental health' rather than just assessing changes in the target animals.

Bird counts are often conducted, as birds are often the easiest creatures to detect and identify. A high number of birds probably does tell us something about the abundance (at least temporarily) of resources, and a high number of bird species (especially if these include several ecological guilds) probably indicates a diversity of resources. We are on shakier ground if we infer from this that the habitat must also be good for most mammals and reptiles, and even shakier if we that because the birds are there, the mammals and reptiles must be there also. Species diversity alone is also insufficient without looking at the actual composition of species, as discussed below.

Ultimately, management associated with conservation objectives aims to ensure that populations of the various species do not decline in size over time as a result of tourism activities (Gill *et al*. 1996), which in turn may affect structure of the community and ecosystem. In many cases, monitoring of abundance or presence/absence may need to be supplemented with observations of behavioural changes or breeding success, as discussed below. This is particularly likely for long-lived

species, for changes that take place gradually, or for species likely to move out of an area altogether after some critical level of stress has been reached.

Selection of indicators depends on the situation, but generally they should be directly observable, relatively easy to measure, directly related to management objectives, sensitive to changing usage, and amenable to management (Vaske *et al*. 1995). They should be selected (on the basis of literature research and site-specific knowledge) to reflect those components that may be negatively affected. Manidis Roberts Consultants (1997) used the following criteria for selecting indicators for monitoring the effects of tourism:

- Degree of relationship with tourist activity (e.g. the number of seals at Seal Bay is directly related to the reason tourists are visiting the beach).

- Accuracy (e.g. number of traffic accidents was considered to be more accurate than perception of parking problems).

- Utility (e.g. the number of visitors probably indicates the level of utilisation of an area more reliably than visitor perception of crowding).

- Availability of data (e.g. data on seals were more available than those on sea-eagles).

- Cost to collect and analyse.

Some further criteria that may be useful are reviewed by Hall and McArthur (1998).

A problem with such criteria is that we may well miss something important by ignoring difficult factors (although monitoring the easiest ones is a substantial improvement over the usual absence of monitoring). The animals of most concern are often those that are rarely seen because of low numbers, or because they are sufficiently disturbed by human activity they hide immediately upon detecting human presence. These are also obviously among the most difficult to accurately monitor, requiring time, patience and expert knowledge

(including good amateur naturalist skills). Myers *et al*. (1984) consider it would be cost-effective to use indicator species of the 'few taxonomic groups which are core members of key guilds in a given community.' We should not ignore insects: if all is not well with them it may affect vertebrate wildlife, and some insects are in themselves interesting to many tourists (especially butterflies, dragonflies, stick insects, praying mantis and large or colourful beetles). Several of the papers edited by Ponder and Lunney (1999) offer advice on the use of invertebrates as indicators.

What should be monitored depends on what questions are being asked. If for instance a regular spot-lighting tour is being planned, questions would include whether the target animals are going to be negatively affected and either leave the area or alter their behaviour, and whether shy cryptic species and diurnally-active species sleeping in the vicinity are likely to be affected. Thus, as a very minimum, records should be kept on the animals seen on site, preferably with counts of numbers of animals seen each visit. If possible, relevant aspects of their behaviour should also be recorded, such as: the approximate height above ground at which they are seen, the kinds of tree and shrub in which they are seen, and whether they appear to alter their behaviour in response to spotlights or voices: these are all factors which could change in response to repeated tour activities. The setting of cage traps over several nights before the commencement of regular tour activities can be compared with subsequent trappings to see whether small ground-dwelling mammals, un-noticed by tourists and guides alike, are being impacted. Bird counts in the same site might be used over time to see whether sleeping birds that are likely to be encountered diminish in numbers. If a new walking trail is to be constructed close to a gully where many bushbirds nest, then the appropriate factors to monitor might be abundance of particular species, diversity of species, breeding success, height of nest above ground, and what kind of tree or shrub the nests are built in: changes in any of these over the years may point to problems.

In studies relating to the environmental impacts of tourism developments, indicators are often chosen quite arbitrarily, without knowledge of the relationship between the tourism variables and the indicator (Warnken and Buckley 2000). Our understanding of the

nature of relationships between tourism-related variables and impacts of tourism on wildlife is still insufficient to enable managers to predict the most likely impacts in many cases, especially for Australian animals (section 3 generally, summarised in Section 3.4). This in turn makes it difficult to choose appropriate indicators. This is probably a combined effect of:

- the complexity of interacting effects;
- the lack of major coordinated research efforts, focusing on key issues of management concern; and
- lack of funding.

In studying the impacts of tourism on wildlife, one or more of the following may be monitored:

- presence or absence of particular species (either species deemed important to the tourism industry, species of particular conservation concern, or indicator species chosen to assess more general effects on wildlife and habitat);
- numbers of individuals of particular species;
- numbers of species of particular taxa (e.g. birds, arboreal marsupials, butterflies);
- breeding success of particular species;
- habitat quality (e.g. area covered by continuous forest, numbers of hollow trees or nectar-bearing plants); and
- animal behaviour or physiology (watching for signs that animals are habituating, foraging in suboptimal areas, experiencing stress etc.).

Species selected for the above would most usefully be those which might indicate a conservation problem (such as those thought to be most sensitive to the kinds of disturbances in question), but may also include species of particular interest to tourists.

Presence/absence, numbers, and species diversity

Simple presence/absence data can be useful if recorded consistently over time, and can be undertaken to some extent during tours (or eco-lodge guest activity). Recording the presence of species at each site visited during each tour is time-consuming, even without counting them. A well-designed check sheet however makes it possible to quickly tick boxes, at least for the key species, and jot down anything out of the ordinary (e.g. a bushfire) which may have over-riding effects. Such records can assist in assessing changes in animal abundance and movements. If a particular species was sighted almost every week in 1997 but during only a few weeks in the entire year of 2000 this would generally suggest a decrease in abundance had occurred. Again, if it is seen in several localities for several years but then only at one or two for a few years, its range may be shrinking. Such information will be more valuable if the operator makes some attempt to compare between the sites visited by tourists and site not often visited. The records have a bonus of building into an extremely useful information base for the operator planning details of guest activities (for instance predicting which sites particular species are most likely to be seen in particular seasons, or which flowering or fruiting trees are likely to be visited by various birds, bats and gliders).

Where time permits, an actual count of key animals is preferable, especially if observations are generally one or very few, as it has more potential for showing a decline in numbers before this reaches zero! If observations are conducted in appropriate and standardised ways, records of numerical counts also offer a wider scope for statistical analysis and graphical representation to enable detection of trends in animal populations over the years (see section 4.3.2).

The diversity of species (even in its simplest form of counting numbers of species seen at each site) is one measure often used to determine whether all is well with a native habitat, and a decline in numbers of species over the years may well be a sign that something is going wrong. There is a danger however in putting too much emphasis on number of species without some restriction on which species to include. For example, one may obtain a higher list of species at the edge of a forest than in the interior because species of more open habitats (including the edge habitat itself: see Catterall *et al*. 1991,

Green and Catterall 1998) are present, while the diversity of true forest species may actually be considerably lower at the edge. Thus an estimation of the diversity of species known (from existing literature) to be true forest species, rather than primarily inhabiting forest edge or more open habitats, would be more relevant in this case.

Breeding success

Animals may be seen for many years in a particular locality but may still be in trouble if their breeding success is decreasing. This may not always be obvious when long-lived residential species are involved, or when there is a periodic in-flux of non-breeding animals from elsewhere. For such species, measurements of breeding success can provide a valuable early-warning sign that a change is required in tourism activity or management. For some species (for instance those with large and overlapping home ranges or living in dense habitat types) it may be easier to assess breeding success than to measure abundance. The presence of many immature gorillas was seen by McNeilage (1996) as a sign that tourism was not adversely affecting a colony. It is relatively easy to note approximately how many female kangaroos have pouch young (of a size to cause distention of the pouch) or joeys at foot, or whether bird nests (especially in relatively open areas such as eucalypt woodlands or coastal colonies) produce nestlings that survive to fledging. Many birds suffer heavy mortality during the first year, so survival to age of one year may be a useful indicator. Some degree of expertise may be required to accurately gauge this however, as many birds for instance show quite subtle differences between juvenile and adult plumage.

Changes in habitat quality

If there are concerns that tourism activities may affect habitat (e.g. through trampling, use of firewood), then monitoring habitat variables may be of interest not only in itself, but may be an indirect indicator of impacts on wildlife which depends on that habitat. Manidis Roberts Consultants (1997) used changes in total native vegetation cover as a measure of habitat quality for wildlife on Kangaroo Island. This is certainly more than has been attempted for most tourism regions and is to be commended, but will not yield much information about whether the needs of wildlife are being met. For this further relevant detail is desirable. For instance, in eucalypt forests surrounding campsites or in forests used jointly for recreation

and cattle-grazing or forestry, notes could be taken on the diversity of shrubs, the presence of trees with hollow limbs, rocks and logs, and the presence of introduced species. Some notes of any quality are better than none, but quantitative measurement is always preferable, even if lack of time necessitates a somewhat subjective one. An estimate for instance – preferably by the same observer each time – of the number of species of woody shrubs seen from one or more vantage points will be far more useful as a comparison in future years than a vague 'reasonable diversity of understorey plants.' In areas of heavy foot traffic, such as near campgrounds or popular swimming holes, soil compaction is easily tested with a potentiometer. Anderson and Keith (1980) used the amount of footprints, trampling, beer cans and film wrappers to assign levels of human disturbance (none, moderate and heavy) in seabird colonies.

Changes in animal behaviour or physiology
Changes in animal behaviour or physiology have the potential to inform us whether:

- Animals are being negatively disturbed by tourism activity in ways that may affect their survival, well-being or breeding success (as illustrated in Section 3.2); again this might provide an 'early-warning sign' or may be easier to measure than population-level effects.

- Animals are habituating and therefore not wasting energy reserves or abandoning offspring or good foraging sites by fleeing from human activity.

- Animals are starting to behave in a way which is less likely to please tourists who wish to see 'natural' behaviour (e.g. raiding rubbish dumps) or which might become dangerous to visitors.

Since the immediate effect of tourist activity may often be on the animal's behaviour of physiology, understanding of these effects should also provide strong clues as to how tourism may need to be modified should negative effects be detected. Some forms of monitoring of animal behaviour can have the added benefit to tourism operators that they can better predict a species' whereabouts

and activity patterns, to provide guests with quality viewing opportunities.

Before the initiation or expansion of a tourism venture, it would be useful to take notes on the daily feeding patterns of animals, nest heights of birds, use of trees near roads or walking tracks at night, and other factors which may potentially change as tourist activities increase. Quantitative records taken on several occasions and at least two seasons before the commencement of activities is the ideal, but if time and resources are too limited for this some record of careful observation is better than nothing.

Observations of animal behaviour while tourists are present are useful both as an indication that immediate change in human activity is needed (e.g. stop approaching the animal or take the spotlight off it) and as records to indicate long-term changes. When approached too closely, nesting penguins show signs of stress such as head-turning or standing up, thus exposing their eggs or chicks to freezing temperatures, when approached too closely (Giese 1996). Other nesting birds and other animals with young will show signs that they might desert their offspring before they actually do so. Such signals can act as a warning during the actual tour that the group should stop approaching, and perhaps retreat a little. For long-term monitoring purposes, counts could be made of the number of animals which behave this way on first detecting the presence of humans, the length of time they do so, and whether they then resume their original activity or leave the area. A decrease over the months in such response, or in the distance between the animal and the observer when it occurs, would indicate that the animals are becoming less disturbed by human visitation.

Physiological responses of animals in response to tourist activity (see Gabrielsen and Smith 1995) are generally much more difficult to measure than behavioural responses, but in some cases may be practicable and useful. An ingenious method was used by Giese (2000) to indicate stress levels of Adelie penguins in response to different visitor stimuli: artificial eggs containing heart rate monitors were placed in nests while the birds were at sea. This technique was able to detect increases in heart rate prior to appearance of behavioural responses, which nevertheless would correspond to

additional energy expenditure that could affect survivorship during this nutritionally stressful period.

Tourism and management factors
A good environmental monitoring program should quantify not only environmental/ wildlife indicators but also those aspects of tourism activity that might be expected to affect or reflect the level of impact on wildlife. These most commonly involve monitoring visitor numbers, but may also include visitor activities, distribution (over time and space), characteristics and management regimes (Hall and McArthur 1998, Buckley 2000).

General considerations
The most appropriate things to monitor will be dependent upon the major questions being asked, and it is worth spending some time on careful consideration of this before launching into what may be a lengthy exercise which does not answer the most important questions. In the next section we briefly describe how each of the above might be measured and applied.

Techniques for observing or detecting the presence of Australian wildlife for monitoring purposes vary widely, and we cannot do justice to this enormous topic within this report. Some animals are relatively easy to observe directly at the appropriate time of day – such as many birds, kangaroos and some wallabies, some possums and some invertebrates (e.g. butterflies, dragonflies, web-spinning spiders). More cryptic animals (including nocturnally-active species) require more skill, patience and time. Native rodents and small carnivorous or omnivorous marsupials (which may be useful as indicators of ecological integrity) – are often hard to detect without live-trapping (for which a permit is required), although there are various methods for detecting their presence (Triggs 1996). The presence of small, echo-locating bats can be detected by devices known as bat-detectors and analysed by another known as an Anabat.

Unfortunately there are very few references that bring together required information on surveying Australian wildlife, particularly in a user-friendly form. There are a number of useful international texts providing general advice on designing surveys and censuses (for assessing species presence and abundance respectively) of various

animal taxa (e.g. Davis 1982, Bibby *et al*. 1992, Heyer, *et al*. 1994, Sutherland 1996, Wilson *et al*. 1996). There are several references that provide good examples of survey methods that can be used for a broad range of Australian taxa (e.g. Myers *et al*. 1984, Brooker and Braithwaite 1988). However there is no comprehensive text directly providing advice on how to conduct surveys or monitoring of Australian animals, and little even for individual species (one exception is Southwell 1989). Much relevant information exists, but is diffusely available through the scientific and management literature, and/or in the collective experience of scientists, consultants and managers. There is a need to collate this information into readily useable forms suitable for application by managers. This would have application far beyond the field of tourism impacts.

4.3.4 What is currently monitored in Australia?

In principle, some data useful for monitoring comes into conservation agencies fairly regularly (for instance returns required from commercial tour operators in some protected areas, reports of research for which permits have been obtained, environmental impact assessment, and the Nature Search project in Queensland). However to our knowledge in practice these are rarely analysed to assess population changes in tourism areas.

Specific species involved in wildlife tourism for which monitoring occurs that were cited by key informants were: eagles, penguins, albatrosses, dolphins and whale-sharks. Success of calf-weaning and survival is monitored at Monkey Mia. Life histories of sea lions at Seal Bay are monitored through microchipping of individuals. Habitat of rock wallabies and feeding of woylies is assessed in Western Australia. In some cases both visitor numbers and the target wildlife populations are monitored. For example, numbers of sea-lions are monitored at Seal Bay as part of the TOMM. Monitoring at Mon Repos involves tagging all nesting turtles and recording detailed information such as tag number (for recaptures), carapace dimensions, date and location where the turtle was examined. According to the management agency concerned (Queensland Parks and Wildlife Service), monitoring of the turtle population and visitation levels over the years shows tourism to have had no detectable effect on the nesting turtles. This is indicated by many turtles returning for subsequent nesting

seasons, including some that have been returning to Mon Repos for over 20 years (C. Gatley, pers. comm.). At Phillip Island Penguin Parade, detailed monitoring of numbers of penguins has been conducted since 1977, supplemented by intermittent monitoring of numbers of burrows and tracking of individual birds (through banding) (Dann 1992).

Some tourism resorts have been required to undertake environmental impact assessments that are meant to include a monitoring component, but it is not clear to what extent this applies to those that feature wildlife tourism. Moreover, out of 175 Australian tourism developments subject to EIA during 1980-1993, only 13 were subject to formal environmental monitoring programs (Warnken and Buckley 2000). However with respect to majority of wildlife tour businesses, many of whom operate in public protected areas, monitoring and management is undertaken principally by government conservation agencies. In some cases, particularly in the Great Barrier Reef Marine Park (*ibid*), larger tourist facilities (many of which include wildlife tourism based on underwater life) are required to undertake environmental monitoring as a condition for operating permits. For most small accommodation-based tourism operations that feature wildlife (such as host farms and small resorts) formal environmental monitoring is highly unlikely to occur.

4.3.5 Conclusion

Monitoring is an essential component of any management plan, since without it there is no way of knowing whether the management techniques are working. What is to be monitored depends on many factors, including the major questions to be asked and constraints on time and other resources, and the plan for systematic observation worked out carefully in advance. Ideally, quantitative data should be collected several times during the year (and at least in two different seasons), monitoring should begin well before tourist activities commence on the site, and there should be at least one control site where tourism activity will remain low or nonexistent. As far as possible, other scientific principles relating to monitoring (section 4.3.2) should also be applied.

If – as will often be the case – there is simply not enough time to monitor very much at all, then some information is still better than none. The recording of when and where species are seen by operators may still reveal changes over the years and suggest problems that can be investigated. There will be a side benefit of such records in informing tour operators where best to go in particular seasons to show certain species to their customers, and how to expect them to behave.

There is a serious lack of information on suitable monitoring indicators and techniques to use for the various taxa of Australian animals. This is an important area for future research. We believe that compilation of information which does currently exist into a handbook that is usable by ecologists, managers, operators and amateur naturalists would also be of great value in encouraging implementation of effective monitoring programs. Such a handbook would require collaboration between scientists and users to reach effective compromises between scientific validity and a sufficient probability of adoption.

4.4 Stakeholder Involvement

The discussion so far has dealt only with natural resource management issues relating to limiting the negative effects of wildlife tourism on wildlife and habitats. There is increasing recognition that a key element of natural resource management is the understanding and incorporation of the perspectives of stakeholders. For example Duffus and Dearden (1990) advise that 'both human and ecological dimensions must be understood. ... to ignore either is to invite conflict...'. In recent decades there has been a large increase in the extent of public interest and involvement in environmental decision-making in the US (Wright 1998) and other more developed countries like Australia. In particular, the role of activist groups is increasingly strong, such that protected area management authorities sometimes believe that conservation principles are compromised (*ibid*). The wide range of stakeholders that are potentially involved in wildlife tourism decision-making in Australia are discussed by Higginbottom *et al*. (2001a). Some of the types of potential conflicts are reviewed briefly below to show the complexity of the issues and the importance of being able to deal with stakeholder perspectives as part of the management process.

Probably the most critical conflict from an environmental perspective is that sustainable management of the natural resource base may be threatened by exploitative interests from the tourism industry. For example, Wallace (1993, pp 59) writes in relation to the Galapagos National Park that 'because of the rapid growth, overwhelming presence, diversity, monetary resources, and political momentum of the private sector, it is now much more difficult for park managers (who do not have an equivalent presence) to plan or implement decisions about site quotas, group size, acceptable levels of impact, zoning, tour scheduling, guide training, and other aspects of visitor and concessions management.' According to WTO and UNEP (1992), many researchers were concerned that excessive use and lack of control over visitation levels was causing environmental degradation to the Park. An example of such a conflict relating to wildlife tourism in Australia is the case of Tin Can Bay in Queensland, the site of a tourism activity based on feeding of free-ranging dolphins. The activity is technically illegal and there are concerns about (among other things) the potential for life-threatening collisions of dolphins or tourists with boats that are launched in the area. However local tourism interests, supported by the local Council who recognise the economic benefits it brings to the area, have lobbied for a continuation of the practice, but with various attempts to reach a compromise as to the management of the activity. A range of different stakeholders have become involved in the issue, and it has been fraught with conflicts and lack of progress for a period of years. The need for a politically agreed process to reach a solution that is not detrimental to the animals is clear.

Problems arising from the different perspectives and priorities of natural resource managers and nature-based tourism operators in Australia are reviewed by Moore and Carter (1993). Discussions with senior personnel in natural resource management agencies revealed their perceptions that operators do not understand the conservation ethic or resource fragility and are overly influenced by the profit motive. Meanwhile nature-based tour operators who were interviewed perceived that resource managers did not understand the profit imperative, the costs involved in running and managing their operations, or the motivations and needs of travellers. Interviews of a wide range of key informants involved in wildlife tourism conducted by Moscardo *et al*. (2001) indicated that there are a number of

sources of tension between tourism operators and protected area managers specifically relating to wildlife. The key problem was that operators were generally seeking greater access to wildlife, while managers sought to restrict access and proximity of visitors to wildlife. Clearly, an increase in mutual understanding is important to resolve such conflicts.

Conflicts of interest can also occur between wildlife tourism interests and host populations (see Palmer 2000, Burns and Sofield 2001). Many land-owners in the Beaudesert Shire (Queensland) have expressed distrust or even hostility towards any increase in nature-based tourism (pers. obs.). There has been antagonism of local cattle-owners and Aborigines to tourism in far north Queensland (Strang 1996). This was related to impacts of tourism such as bogging of tourist cars (with resultant requests for help), breaking of fences, shooting of pigs and wallabies, lighting of fires, disturbance of cattle, and over-fishing.

Management often needs to cater for different types of tourists, such as by creating zones for wilderness seekers and mass tourists within protected areas. The experience of wilderness seekers will be marred if facilities in the mass tourism zone can be seen or heard from the wilderness zone. This means we need relatively large areas to cater for a small number of people seeking natural experiences, which has sometimes brought the charge of elitism. Coupled with the fact that moving off trails has the potential to bring more visitors into contact with shy wildlife, trample vegetation and litter remote places, some argue against the idea of catering to such needs. However, the appeal of an area for wilderness-seekers may in some cases be a good indicator that a sufficient area of natural vegetation to support a good diversity of wildlife.

There are differences in the types of experiences sought even between different wildlife tourists in natural areas. Some bird-watchers are avid twitchers, intent on adding to life lists and not staying to watch once a bird is identified, while others are more interested in watching the behaviour of birds. Some bird-watchers thrill to long hikes and tough climbs to see a rare species and others prefer to view animals from comfortable vehicles. Knowledge of segmentation within the wildlife tourism market is briefly reviewed by Moscardo *et al*. (2001), who

show that a key dimension along which visitors vary appears to be their level of specialisation. Such differences between visitors can lead to conflicting needs. For example Higham (1998) advises that in providing a level of interpretation suitable for wildlife generalists the appeal of the attraction to wildlife specialists will be compromised.

In addition to resolving conflicts between stakeholders, effective public participation in planning and decision-making has the benefits of providing a source of further knowledge, avoiding subsequent political conflicts and building levels of mutual trust and 'comfort' (Thomas 1998). On the other hand, it raises costs in terms of time and money, and it has been argued that public participants may not be broadly representative, and bring subjectivity and misinformation into the process (*ibid*). Nevertheless the general consensus is that sustainable management of wildlife tourism requires a mechanism for identifying stakeholders and considering their different perspectives in the planning and management process. Some of the key issues that need to be considered are further reviewed by Hall and McArthur (1998) and Burns and Sofield (2001).

4.5 Overall Management Framework

As reviewed in section 4.2, there are many techniques that can be used to reduce negative effects of wildlife tourism on wildlife and habitats. Ideally these should be applied as part of a comprehensive planning and management process designed to manage negative effects of wildlife tourism (or nature-based tourism generally, as it frequently involves wildlife habitat) according to defined objectives. Seen from this broad perspective, monitoring, evaluation and stakeholder involvement are part of the management process.

Management does not exist in a vacuum: it is directed at certain objectives, and it is important that these objectives are made explicit and agreed to by key stakeholders. Decisions about objectives and what levels of impact are acceptable are in practice often largely political (Lindberg and McKercher 1997). Particularly for government-run facilities, such as protected areas or certain large wildlife tourism attractions, they will be strongly guided by relevant policies and legislation. Monitoring is useful only if there is an effective mechanism for determining whether management objectives for reducing

negative effects are being met and ensuring that remedial actions are taken when this is not the case. These actions may range from complete curtailment of the activity, through a reduction in the scale of the activity (e.g. by reducing visitor numbers), to investment in additional mitigation measures. A clearly articulated process is needed to ensure that these elements are brought together in a coordinated fashion. Where possible, these should be part of a documented management plan or similar document.

The following are generally agreed to be key elements that should be incorporated into any management framework for a tourism activity or development in a natural area (where the scale is such that there is cause for concern) to ensure sustainability of the natural environment (including wildlife):

- Clearly stated and agreed management objectives, including a statement about protection of the wildlife and its habitat.

- A suitable monitoring program (reviewed in section 4.3).

- A mechanism for feedback from evaluation of monitoring into management actions.

- Appropriate choice and implementation of management actions (reviewed in section 4.2).

- An adequate process for stakeholder participation in management process (see section 4.4).

- A clearly defined management framework that brings the above elements together (cf Boo 1991, Shurcliff and Williams 1991, Knight and Gutzwiller 1995, McArthur 2000).

A number of different management frameworks or models have been proposed for managing environmental (among other) impacts of nature-based recreation, and are equally applicable to tourism based on wildlife in natural areas. The major frameworks are reviewed below, and vary according to a number of key features:

- The relative focus on the initial development process as opposed to ongoing management.

- The spatial scale to which the framework is meant to be applied (a single development or activity, a protected area, or a whole region).

- Whether they focus on intensity of use or environmental impacts.

- The relative emphasis on environmental, visitor and host community concerns.

- The amount of resources likely to be needed for effective implementation.

Environmental Impact Assessment (EIA) is normally used prior to a project or development taking place, although in its full expression it also includes ongoing monitoring, evaluation and feedback into management. It is normally applied to a specific development, rather than to a geographical area. In cases where the project proceeds, the process is designed to ensure that its design and management will minimise any potential negative environmental impacts. The EIA process is triggered only when it is considered that the project 'could reasonably be considered' to have 'significant' environmental impacts. In most States in Australia, this is a discretionary decision made by government, and is based on considerations such as scale of the development, conservation value of the area (including potential to impinge on a national park or certain other protected areas), resilience of the natural environment and degree of expected public interest (Thomas 1998). Details of these criteria differ between States. Thus in the case of wildlife tourism, it is likely to include development of major infrastructure in natural areas, such as a new pontoon on the Great Barrier Reef or a new lodge adjacent to a protected area, but not the majority of wildlife tourism operations that involve tours or small-scale accommodation. The major stages of an EIA are:

1. Screening – to determine if the project requires an EIA

2. Scoping – to determine the key potential impacts and provide guidelines for scope of an Environmental Impact Statement (EIS), and often involving public input

3. Preparation of an EIS – including description of the environmental baseline (without development), prediction of direction and magnitude of potential impacts, and proposed mitigation measures

4. Evaluation of the EIS by government after a process of public consultation – leading to a decision regarding approval of the project, and if approved whether any conditions should be adopted, such as additional mitigation measures and requirements for monitoring (Thomas 1998, Harvey 1998).

Although there is no formal requirement for EISs to include monitoring programs, they are often included, though it has been argued that the proposed programs are typically poorly designed (see section 4.3). While there is general agreement that the EIA process is worthwhile, opinions vary as to their level of effectiveness in ensuring sustainable management of the natural environment (Harvey 1998). A key criticism has been that EISs are prepared by the development proponent (or their consultants) and therefore are not impartial (Buckley 1991b). Of particular relevance for wildlife tourism, a key problem with the EIA process is that it does not cater for cases of multiple small operations which may collectively have significant environmental impacts (Buckley 1998b).

A related process applying only in New South Wales is the Species Impact Assessment process. This is required when a new development is planned to occur on land that contains 'critical habitat' or is 'likely to significantly affect threatened species populations or ecological communities or their habitats' (under the *Threatened Species Conservation Act 1995* and *Environmental Planning and Assessment Act 1979*).

There are recent moves to embed components of the EIA process within other resource management and planning processes, to remove the need for formal EIAs (Harvey 1998). An increasing number of larger businesses are also moving to develop their own resource

management and monitoring programs (Thomas 1998), and this also seems to apply to the small number of large tourism attractions based on free-ranging animals in Australia.

The other models discussed below are designed to facilitate ongoing sustainable management of areas used for nature-based recreation, although their use should ideally begin in the planning stages.

One of the simplest models is based on keeping levels of visitor use below a specified **carrying capacity** (Glasson *et al*. 1995). It involves determining a threshold level of visitor activity above which the resource base will deteriorate (including considerations of effects on the environment, visitors and host communities). There is now general consensus that this model is overly simplistic, has not proved a successful tool in managing impacts of tourism, and that it is better to focus on impacts, rather than levels of use (e.g. Ceballos-Lascurain 1996, Wearing and Neil 1999, McArthur 2000) (see also section 4.2.1).

The **Recreation Opportunity Spectrum** (ROS) framework (Clark and Stankey 1979) involves a zoning approach to management. A geographical area such as a national park is zoned into a spectrum of 'settings', each of which provides different recreational 'opportunities' and can provide different activities. These are determined based on factors such as environmental sensitivity and the desirability of particular uses. The concept incorporates the idea that managers should adjust environmental management practices according to the most desirable form of recreation and its likely impacts. The standard range of recreational classes established by ROS are: developed, semi-developed, semi-natural and natural. Zoning takes into account both environmental and visitor issues. According to Hall and McArthur (1998), the ROS has been applied to Fraser Island National Park, but has had limited application elsewhere in Australia. However, key elements of this approach have been widely incorporated into management planning of Australian protected areas via zoning systems. ROS is not however sufficiently comprehensive to provide an overarching framework for management of environmental impacts of nature-based tourism.

An essential component of more comprehensive management frameworks is to determine what level of negative effects of an

activity on the environment are sufficient to trigger management actions. Probably the most popular approach to address this issue is based on specifying thresholds known as '**Limits of Acceptable Change**' (LAC) (Stankey *et al*. 1985), which is also the name given to a management system based on this technique and reviewed below. This involves deciding the amount of negative change in specified measurable indicators that should trigger management action. Where resources exist to monitor these changes, this is generally seen as more useful than the more simplistic carrying capacity approach. The magnitude of levels of change that are considered acceptable is a matter of judgement depending on the management objectives and species or situation concerned. For example, in the case of an endangered species, any detrimental change at all may be considered unacceptable. In management frameworks such as the one above, 'standards' can simply be replaced by limits of acceptable change.

The **Visitor Impact Management Model (VIMM)** (Loomis and Graefe 1992) involves the following steps:

1. Review existing information
2. Determine management objectives
3. Select indicators and determine how to measure them
4. Restate management objectives in terms of desired conditions for indicators in quantitative terms (known as 'standards', though equivalent to limits of acceptable change)
5. Measure indicators through research or monitoring
6. Determine whether any indicators fail to meet desired conditions
7. If so, identify probable causes of negative effects
8. Determine appropriate management strategy(s) to address changes
9. Implement management
10. Return to step 5

The VIMM has been pilot tested in at least ten natural heritage sites in North America (Hall and McArthur 1998) including a set of US sites popular for viewing of shorebirds (Vaske *et al*. 1995), although this had not at the time of study involved an ongoing monitoring process. In the latter study, the overall management objective was determined to be: 'balancing preservation with recreation'. Indicators were selected to reflect these objectives: measures of disturbance to the birds and dune vegetation, and measures of the visitors' satisfaction with their experience. Ecological research was conducted to help understand how human use affected the shorebird populations and other elements of the ecosystem. These revealed some of the components of human use that were most critical in determining levels of environmental impact, such as pedestrian as opposed to boat based activities, and trampling. Management actions designed to address these particular components were implemented. Simultaneous surveys of visitors determined that some of the beliefs held by visitors conflicted with management goals, and allowed design of a targeted educational strategy. A version of VIMM is also being applied to the Jenolan Caves (New South Wales, Australia), with biological indicator organisms including a range of cave and surface fauna (Mackay 1995).

The **Limits of Acceptable Change (LAC)** model builds on the LAC technique mentioned above and the ROS (Clarke and Stankey 1979), and involves the following steps:

1. Identification of concerns and issues

2. Definition an description of opportunity classes

3. Selection of indicators for conditions

4. Inventory of resource and social conditions

5. Specification of standards for indicators

6. Allocation of alternative opportunity classes

7. Identification of management actions for each alternative

8. Evaluation and selection of preferred option

9. Implementation of actions and monitoring of conditions.

It is thus very similar to the VIMM, except for the incorporation of the ROS model, a slightly different sequence for determining suitable indicators and identifying problems, and consideration of alternative opportunity classes. Authors differ in their evaluation of the LAC Model. McCool and Cole (1997) review its considerable use in the USA and state that it has led to a number of substantial benefits, and Ceballos-Lascurain (1996) states that it 'has proved itself to be a valuable management tool in several wilderness areas in the USA'. Others outside the US state that it has rarely been successfully applied due to a lack of support from stakeholders (Wearing and Neil 1999, McArthur 2000).

The **Tourism Optimisation Management Model (TOMM)** was developed in Australia 'not only to monitor tourism activity and impacts, but to help people make better decisions about tourism' (Manidis Roberts Consultants 1996). The proponents of this approach argue that by building stakeholder participation strongly into all key phases of the model, it has a greater chance of being successfully adopted than the models reviewed above (McArthur 2000). It also differs from the previous models in being designed for a regional approach rather than for a single protected area, although its application could also be appropriate for a park where there are a range of conflicting interests. Most of the components of TOMM, however, are similar to those of the LAC model. A detailed manual instructs how to apply TOMM, with the specific example of its application on Kangaroo Island. In that case, steps included workshops and interviews with stakeholders, briefings with senior government staff, tourism newsletters and media releases (Manidis Roberts Consultants 1997). Optimal conditions, associated indicators and acceptable ranges for those indicators were determined jointly by the consultants and stakeholders. These included economic, market opportunity, experiential, socio-cultural and environmental components; the latter are shown in Table 5.

Table 5: Environmental Component of Monitoring System for TOMM on Kangaroo Island

OPTIMAL CONDITION	INDICATOR	ACCEPTABLE RANGE
The majority of the number of visitors to the island's natural areas occur in visitor service zones	Proportion of KI visitors to the island's natural areas who visit areas zoned specially for managing visitors	85-100% of visitors
Ecological processes are maintained or improved in areas where tourism activity occurs	Net overall cover of native vegetation at specified sites	0-5% increase in native vegetation base case
Major wildlife populations attracting visitors are maintained and/or improved in areas where tourism activity occurs	Number of sea-lions at Seal Bay and seals at Cape De Couedic. Number of hooded plover at designated tourist site (one only) Number of osprey at designated tourist site (one only).	0-5% annual increase in number sighted
The majority of tourism accommodation operations have implemented some form of energy and water conservation practice .	Energy consumption/visitor night/visitor	3-7kW
	Water consumption/visitor night/ visitor	20-40l

Source (McArthur 2000, supplemented by F. Vickery, pers. comm.)

While TOMM has been widely commended (e.g. Wearing and Neil 1999, Office of National Tourism 1997), it is too early to properly assess its effectiveness. With regard to its application on Kangaroo Island in terms of wildlife, the number of indicators chosen seems inadequate to detect the range of potentially important negative impacts that increased tourism might have on wildlife. Animal road kills, fragmentation of wildlife habitat, habitat damage and increased pressure on alternative wildlife were all identified as potential problems in the TOMM scoping process (Manidis Roberts Consultants 1996), yet none of these are incorporated into the monitoring program. Perhaps this is a cost resulting from the strong emphasis on stakeholder participation, or perhaps it simply reflects lack of resources for comprehensive monitoring – a problem not limited to TOMM (see section 4.6).

Whatever management framework is used, it needs to be documented and given the status required for implementation. In terms of individual attractions or for protected areas, this would normally be through its inclusion in a management plan. Certain large wildlife tourism attractions – such as Phillip Island Nature Park – also have their own management plan. By contrast smaller tourism businesses often have a business plan, but it only rarely includes environmental management issues. Since long-term sustainability of businesses requires protection of the environment as well as the visitor base, this seems to be an important gap that should be addressed.

The appropriate scale at which monitoring and management should occur depends on the type of wildlife tourism activities concerned and the level of likely impacts. Individual wildlife tourism attractions that have the potential for significant effects would generally require their own self-contained system of management and monitoring. However the majority of wildlife tourism activities involve many small operators of similar types. Where these occur within protected areas, it makes sense for monitoring and management to occur principally at the level of the protected area as a whole, and to occur within the wider context of management of the ecosystem. The management frameworks discussed above have been developed principally to address management at the level of protected areas or region. Nevertheless for small operations both within and outside protected areas, a simple management process undertaken by operators is desirable, and the same key elements are necessary. The main difference would be the level of sophistication of the techniques employed.

In cases where wildlife tourism is just one component of broader nature-based experiences, then management of wildlife tourism will generally occur in the context of a management process for nature-based recreation. In situations where there is a particular visitor focus on a wildlife population, especially where there are reasons for concern about potential impacts, then a management process focused on this situation may be required. Often both approaches will be needed. For example, on Kangaroo Island, the TOMM process includes several wildlife species as indicators of impacts of tourism (including wildlife tourism) across the island. At the same time, a more intensive management process (including monitoring) has been

implemented at Seal Bay, a Kangaroo Island tourism attraction that is based on a colony of sea lions which attracts large numbers of visitors (Vickery 1994).

To conclude, no matter what the scale and context (and not matter who is undertaking management) the following are key components that should be part of management of wildlife tourism:

1. Defining clear management objectives in relation to environmental impacts.

2. Appropriate management measures for mitigating these impacts.

3. A process for monitoring these impacts, and for providing feedback from monitoring into management.

4. Documentation which makes the above explicit and guides the actions of the organization.

4.6 Other Requirements for Effective Management

Choice of an appropriate management regime is however only part of what is needed for sustainable management of wildlife tourism. A lack of adequate funding for researching, monitoring and managing the effects of nature-based tourism on the natural environment (including wildlife) is perhaps the most severe constraint on effective management, and seems apply to most Australian government conservation agencies. While visitation levels to protected areas in Australia and elsewhere have continued to increase, budgets have generally not kept pace with such increases (Lindberg and McKercher 1997, Buckley 2000, QPWS 2000b). Similarly, McPhee and Hale (1995) state that there the funding available for management of inshore fisheries is much less that what is required to ensure sustainable use. Regarding lack of sufficient funds for research and monitoring, Buckley (2000, p35) summarises the problem thus:

> *'science funding agencies considered it too applied; tourism funding agencies think it too expensive and don't recognise its significance; national parks management agencies recognise its significance but have inadequate budgets to support it; and the*

tourism industry itself has little interest in quantifying its own impacts.'

It seems that in the face of this dilemma, the decision is often made to forego monitoring or formal evaluation of the effectiveness of management. This is a critical problem in that it is impossible to ensure sustainability without monitoring. Similarly, choice of management tools is apparently largely governed by cost. In particular, the use of education as a management tool in protected areas in Australia and elsewhere is often limited by low levels of funding (Beckmann 1987, Doucette and Cole 1993). The current discussion paper for a new Master Plan for Queensland's Parks (QPWS 2000b) recognises a need to increase interpretative programs and monitoring of the impacts of visitor activities – but in reality if resource levels are not increased this is unlikely to be feasible. The problem of lack of funding for adequate monitoring needs to be addressed from several perspectives:

- Levels of funding and skill urgently need to be increased to improve the capacity for scientific monitoring among natural resource management agencies and tourism operators. The most obvious way to increase funding is to increase the budgets of State conservation agencies – clearly a highly political decision. Secondly, there may be opportunities for operators to pool small amounts of funds towards cooperative monitoring efforts – again not likely to be a politically popular direction. Alternatively there are several ways in which revenue from tourism can be more effectively channeled into funding for resource management than is currently the case in Australia (see Davis *et al*. 2000, Higginbottom *et al*. 2001b). Raising levels of skill ideally requires provision of training (from government funded agencies such as the CRC for Sustainable Tourism or a State conservation agency), supported by production of practical written (or electronically based) guidelines.

- Creative ways to reduce costs of monitoring need to be found. This may include greater involvement of operators and tourists in monitoring as a part of the tourism experience (see Higginbottom *et al*. 2001b), thus involving little additional cost. It may entail the use of volunteers to conduct monitoring.

Volunteer programs have worked well in situations where the volunteers feel they are contributing to conservation goals and where good relationships exist between staff and volunteers, such as at Binna Burra Mountain Lodge in Lamington National Park (pers. obs.) and Cape Byron Headland Reserve (Brown and Essex 1997). Most importantly, monitoring techniques need to be designed with a view to minimising costs while maintaining the ability to detect differences of a scale considered to be of concern.

- Where costs preclude monitoring at desirable levels of precision, low levels of precision may need to be accepted, along with application of the precautionary principle.

'The precautionary principle' is a term originally coined by Hare *et al*. (1990) stating that: 'Policy decisions should err on the side of caution, placing the burden of proof on technological and industrial developments to demonstrate that they are ecologically sustainable.' This principle has proved a welcome antidote to the view of many decision-makers that projects should not proceed unless proof can be provided that the environment will be negatively affected. Taken to extremes however, it would prevent most projects (as there are always some unknowns). Uncritical use of this principle can also backfire: a proposed tourism development on well-vegetated private land may be blocked by use of the precautionary principle and the land-owner decides instead to clear the land for agriculture (for which in many areas no permit is required). In practice, the approach recommended by The Intergovernmental Agreement on the Environment 1992 (which covers the Commonwealth and all States, the Territories and Local Government), is a reasonable compromise:

> *'Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
> *(a) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and*
> *(b) an assessment of the risk-weighted consequences of various options.'*

This can be supplemented by use of adaptive management (Holling 1978), whereby development is allowed to proceed on a trial basis at a small scale, and feedback from monitoring is carefully used in an ongoing fashion to adjust management.

There remains, however, a need to clarify how the precautionary principle should be applied in relation to new wildlife tourism developments or activities. If it is not possible to detect substantial changes in wildlife populations because of limited resources for monitoring and/or inherent difficulties in obtaining precise estimates of biological parameters, a decision needs to be made as to whether a tourism activity should proceed. In cases where there is (a) good reason to expect detrimental effects, (b) very high levels of uncertainty about possible effects and/or (c) the species or ecosystem in question is of high conservation value, we propose that development should not proceed. However in cases where alternate land-use is likely to involve serious habitat alteration (such as clearing for agriculture or subdivision for housing), this should be weighed against the potential effects of the proposed wildlife tourism venture.

Another major obstacle to effective management of wildlife tourism is that our understanding of the nature of relationships between tourism-related variables and impacts on wildlife is still insufficient to enable managers to predict the most likely impacts in many cases, especially for Australian animals (section 3). In particular, we know little about the relative importance of the various components of visitation (visitor behaviour, numbers, frequency etc) – yet such knowledge is essential in deciding what components to manage and in choosing appropriate monitoring indicators. This lack of understanding is probably a combined effect of:

- the complexity of interacting effects;
- the lack of major coordinated research efforts, focusing on key issues of management concern; and
- lack of funding.

When conservation agency informants were asked what research relating to impacts of wildlife tourism on wildlife they thought would

be most useful, they made the following suggestions. These related mostly to gaining a better understanding of the effects of wildlife tourism on wildlife, and of the most effective management approaches:

- Determine effects of an increase in visitor numbers at certain sites on habitats, biodiversity, or particular species (glow-worms and turtles were specifically mentioned).

- Determine how animal behaviour is modified by visitors.

- Determine effectiveness of use of infrastructure in minimising environmental damage.

- Determine ways to improve visitor management.

- Conduct baseline studies of areas before tourism starts.

- Determine positive effects of wildlife tourism on people's attitudes.

A final problem inhibiting effective management is lack of motivation by many private operators to undertake monitoring and management, or to put substantial resources into these. This needs to be understood in the context of the prevailing regulatory environment. For major tourism developments for which there is a legal requirement for an EIA, these EIAs and associated monitoring programs are conducted by the operating businesses and it is not in their short-term interests to demonstrate any negative effects of the development (Buckley 1991a). For the majority of private wildlife tourism operators, however, there is no regulatory requirement for monitoring. Thus an 'economically rational' operator would undertake monitoring only if: (a) they are aware of the potential environmental impacts caused by their activities; (b) they perceive that these impacts would translate into reduced visitor numbers; and (c) the financial cost of monitoring is less than the expected economic benefits. In cases where multiple operators are using a common area, such as a national park, there is a danger that in the absence of regulation the 'tragedy of the commons' (Hardin 1968) may apply, where overexploitation of resources occurs as a result of a system of

open access to communal resources. This problem can be overcome by a regulatory system that has the support of users and has effective enforcement mechanisms (Berkes 1989).

Problems relating to lack of operator motivation can in theory be partially addressed by education of operators about potential negative effects of tourism on wildlife, and by raising their awareness that monitoring can be good business. For instance, signs that platypus are being disturbed (such as not coming out till after dark, or heading back to burrow as a response to voices or human movements) may be a warning that they will nest elsewhere next season, and if platypus-viewing is a major drawcard this could translate into a drop in customers.

A final requirement is that someone takes responsibility for management. Currently the situation in Australia is that the larger tourism attractions based principally on viewing free-ranging animals (e.g. Seal Bay, Mon Repos, Phillip Island Penguin Reserve) are mostly government owned and undertake their own management programs, guided by a management plan or strategy. For tours operating in protected areas, it is generally assumed that the conservation agency takes primary responsibility for management and monitoring. For tours or lodges operating on privately owned land, there is no clear responsibility for management. The optimal situation is however one in which management is undertaken cooperatively between management agencies and operators, all striving to achieve mutually agreed goals of resource conservation.

4.7 Comments By Conservation Agency Informants On Management Of Negative Effects Of Wildlife Tourism On Wildlife In Australia

When asked what the various conservation agencies are doing to assess, monitor and manage impacts of wildlife tourism on wildlife, the informants indicated that little was happening except in a few localised cases, as mentioned in the preceding sections. Reasons given for the generally small amount of monitoring and management of wildlife tourism were that the areas were too large and sparsely populated and lacked appropriate infrastructure for reporting (thus suggesting that levels of staff and funding are the underlying issues).

When asked their opinions on the effectiveness of management measures in place to mitigate negative effects of wildlife tourism on wildlife, the following responses were given by one or more of the conservation agency informants:

- Don't know.
- Most management measures are very local, involving rangers talking to people within the parks.
- There is no focal point where this kind of information is recorded and dealt with.
- This field is in something of a vacuum, awaiting clear policy formulation.
- There is a long tradition of hand-feeding of animals, and such ingrained habits are difficult to combat. Tourism operators usually do the right thing because they will otherwise find themselves out of work, and the main problem is with 'yahoos' rather than guided tours. Registered tour operators constitute only about 5% of visitors and present nowhere near as many problems as casual visitors.
- Monitoring at Shark Bay and Monkey Mia do seem to have resulted in successful adjustments to management policies.
- The Victorian Department of Natural Resources and Environment has one of the few legislated regulations and permit systems covering whale and dolphin watching, and these measures are very effective. However the legislation imposes the onus on NRE to prove that the granting of a permit would be harmful to whales/dolphins – hence the current review/research. Legislation and management for other wildlife is effective.

Particularly difficult management issues were cited as:

- keeping dogs and other pets out of parks;
- inability to be around all the time to monitor feeding of wildlife;

- spotlighting by individuals or groups other than organised tour groups;

- inadequacy of sizes of marine parks for representing marine diversity; and

- understaffing of national parks.

Several informants volunteered suggestions for improvement, although they were not specifically asked for these. One informant thought that working more closely with NEAP in the provision of licenses would be useful. Another felt the policy of 'dobbing-in' of other tourism operators in the Galapagos Islands would be useful here: not only will offenders be disadvantaged but the 'dobbers' are able to jump the queue for licenses.

Conservation agency informants saw the main obstacles to ecological sustainability of wildlife tourism as:

- uncontrolled expansion, especially high visitor numbers in fragile ecosystems (Nimbolin Gorge was given as an example);

- increase in 4WD traffic;

- loss of wildlife habitat;

- contrived experiences to meet visitor demands;

- small operators being forced to cut corners for survival;

- commercial pressures on operators to provide reliable, consistent saleable experiences, leading to disturbance, habituation etc. ;

- external political and economic forces;

- traditional ideas of mass-tourism being the only way to go; and

- lack of political will to contain tourism (at least until we know what is sustainable), especially where limited local resources are concerned.

5. RECOMMENDATIONS

5.1 Identifying Negative Impacts

Before considering action to be taken on actual or potential negative effects (to be addressed in Section 5.2) we need to be able to identify what negative effects might in fact be occurring or be expected to occur.

When considering potential negative impacts of wildlife tourism on wildlife, managers and tourism personnel must consider effects relating to conservation (ie at the level of populations, species, communities and ecosystems) and to animal welfare (at the level of individual animals). They should consider not only the species that are the object of tourism activities, but those that might be indirectly affected, as well as effects on the habitat that might subsequently affect the wildlife.

There is already a considerable body of knowledge on some aspects of identifying negative effects, but this knowledge is very fragmented, and not always in a form which is readily accessed and understood by non-ecologists.

- There is a need for a readable and comprehensive manual accessible to ecologists, conservation managers, tourism operators and amateur naturalists to facilitate the process of identifying negative effects on a range of Australian species and habitats, and for taking appropriate steps to minimise these.

- In the interim, tourism personnel should be aware that wildlife tourism activities such as those discussed in Section 3 of this document can be detrimental to wildlife, acquire what knowledge they can on the topic, and be ever alert to signs that all may not be well.

There are also many gaps in the knowledge that we would ideally possess if we are to manage wildlife tourism in such a way as to minimise negative effects on wildlife. Without research faulty ideas can be repeated and reinforced. Research should include long-term studies. Mills' study (cited by Higham 1998) of an albatross breeding

colony showed no discernible impact by on-lookers, but long-term data analysis revealed significant changes with time (see Section 3.2.4). We are very often forced to make management plans in the absence of detailed knowledge and understanding of processes, but need to progressively refine these as results of research become available. Some of the more urgent needs for research on negative impacts of wildlife tourism on Australian wildlife are presented below.

Spotlighting
Most Australian mammals and frogs, and some birds and reptiles, are nocturnal. The usual method of viewing these is by use of spotlights. Research is needed to determine the following for a variety of nocturnal mammals, birds and other taxa:

- whether the eyesight of a range of species is affected by commonly-used light levels, and if so how long the effect lasts (this is particularly critical for flying and gliding animals which need to avoid obstacles and clearly see their landing sites);

- the effect of different coloured filters and different light levels on behaviour;

- the effect of human scent and behaviour associated with tourism such as voices, rustling of leaf litter or crunching of gravel;

- what level of frequency of spotlighting will cause animals to shift away from the immediate vicinity or emerge from nests later in the night; and

- the effects of alternate ways of experiencing nocturnal wildlife (such as waiting in hides, use of night-scopes, listening for calls) in a way that is practicable for satisfying tourists' reasonable expectations.

Other light and sound
Apart from the lights and sounds referred to in the above section on spotlighting, an increase in human activity often results in an increase of lighting (for safety, comfort and entertainment) at night and an increase of noise both day and night. Such changes may be localised

and their effects minimal, but the following aspects should be investigated:

- how far certain kinds of noise – including but not limited to sounds within the range of human hearing – penetrate through certain habitats (e.g. night-time entertainment in a large resort on the edge of a forest);

- how various kinds and levels of noise (within the range of an animals' hearing ability) affect a variety of wildlife species (including when active and sleeping, and when nesting or caring for young); and

- what effect bright lights might have on local or migrating wildlife.

Critical periods when wildlife are most vulnerable to disturbance
We know in general that many animals are most vulnerable when foraging or when caring for eggs and young, and some also when sleeping or resting. What we lack are the details for many species and groups of species. Some of the major needs are:

- long-term studies on species already subjected to moderate or high tourism levels, to detect changes in nesting or foraging habits to less optimal sites;

- studies of the effect of hikers and bird-watchers on nesting forest birds: how close will different species tolerate approach while courting, building nests, sitting on eggs or feeding young?;

- studies to determine how much sleep is lost for a variety of species in a variety of situations (diurnal birds startled by spot-lighting parties, nocturnal hole-nesters and ground-dwellers disturbed by hikers and picnickers, aquatic and marine animals sleeping on the ground or in burrows traversed by hikers or swimmers) and what effect this has on their behaviour and physiology.

Habitat modification
Habitat loss is accepted as the major cause of biodiversity decline throughout the world. The effects of habitat modification can be less obvious but may have severe effects on wildlife. Modification of forest

and other natural ecosystems around tourism accommodation or walking trails can effectively remove the habitat of some species. For instance: the removal of old trees (sometimes considered hazardous) make it impossible for hollow-nesting species to persist or reproduce; the removal of essential food-plants will make the habitat unsuitable for animals that feed on fruit, nectar, sap or leaves; and the clearing of understorey will destroy the shelter and foraging sites of many small mammals, birds and lizards. An extensive body of knowledge on effects of habitat modification on wildlife already exists which can and should be accessed by planners, operators and managers. Further research is needed into the ecological requirements of some of the rarer and more vulnerable species, and their behavioural response to common tourist activities.

Supplemented food (intentional and accidental)
This is a multi-faceted, emotive and highly controversial topic in relation to which there are many gaps in knowledge. To minimise effects on wildlife of hand-feeding and poorly-concealed disposal of food scraps, we need to know more about what these effects are likely to be. In particular we need to study for a variety of species (including terrestrial and marine mammals, birds, reptiles and fish) in a variety of habitats (including natural habitats, habitats which have been modified to varying degrees, and interfaces between natural and modified habitats):

- how to best approximate the normal food of the species;

- whether the provision of food causes an increase in the population of the animal (which may not be a negative effect where species numbers have declined through previous human interference);

- whether a local increase in the population of the target species causes increased aggression amongst individuals, and whether this leads to notable stress levels;

- whether an increase or decrease in the population of the target species is causing increase or decrease in other species sharing the habitat, especially threatened and cryptic species;

- whether the congregation of animals at feeding stations results in trampled vegetation, damaged to nesting sites, or excess soil nutrients (which can promote weed infestation) and other habitat changes; and

- whether the animals become dependent on the food supply.

Indirect effects of hand-feeding on wildlife that need further research include:

- whether the animals have a tendency to become aggressive towards humans;

- whether participation in close contact and hand-feeding increases a person's likelihood of supporting conservation of species and ecosystems; and

- whether there are alternate activities that allow people to get close to or interact with wild animals with little or no drop in satisfaction.

Animal welfare issues

We know amazingly little about what factors are important to the animals themselves, even for domestic and other common species, and far less is known for most wildlife. Too often opinions are generated and acted upon with very little understanding of the animal's level of ability to suffer in various ways. Two people, both very concerned with animal welfare, can look at the same situation and draw opposing conclusions. A group of wallabies in a free-range enclosure with ample food and snug shelter may be seen by one person as being better for the individual animals than the same group out in the mountains subject to predation and food shortages, unable to keep dry in torrential rain and with no access to treatment for illness or injury. Another may argue that the animal's need to explore, to exercise by bounding for long distances, to meet new members of its species, to set up defended territories and to generally indulge in other aspects of life in the wild will cause frustration and boredom in any captive situation. Dawkins (1983, 1990) has for some years been promoting the idea of 'asking the animal' by setting up experimental situations where an animal must make efforts of increasing intensity

to achieve the opportunity to engage in various activities. Bradshaw and Bateson (2000) briefly review the relationship between wildlife conservation, animal welfare and animal rights (concluding in part that the first two are more often in harmony with each other than either is to the last-named) and present a case-study on hunting red deer as a possible model for decision-making on welfare and conservation issues.

- An understanding of wildlife stress is important both for welfare and conservation: frequently-stressed animals are less likely to survive and breed, and their behaviour patterns may change, causing population decline and even local extinction. Experimentation does not have to cause severe stress to animals in order to be useful. The degree of particular activities such as human approach, spotlight intensity or noise level which causes mild stress level (such as increase in heart rate) could profitably be examined between different species and between situations. This could indicate for instance that it is better to view some easily-stressed nocturnal animals briefly but that others can be safely watched for longer, or that certain songbirds will tolerate birdwatching close to their nests while others are apt to become stressed (even if they do not make this obvious by flying away).

- There would seem to be ample opportunities in sanctuaries and zoos throughout Australia to experiment with animals, which are already captive to determine the kinds of opportunity various species are willing to make the most effort for. There are probably many zoology and psychology students who would welcome the chance to do such interesting studies as post-graduate research.

- Where conservation and welfare issues clash, there is much to be determined as to what extent certain humane acts (such as mercy killing of a wild animal or feeding a starving one) affect the social structure, population numbers or surrounding ecosystem. Too often heated arguments are waged in a vacuum of actual knowledge.

- Culling is another highly emotive issue, and one where animal rights, animal welfare and conservation may all be in conflict with one another. Animal welfare (such as individuals suffering from

starvation) and conservation issues can and should be researched, so that at least the arguments for and against culling and its alternatives can be weighed in the light of reliable information.

- Fish caught for recreation should be immediately dispatched rather than allowed to die slowly of asphyxiation. It is generally well-recognised by responsible hunters that the same applies to animals inadvertently injured rather than killed outright during hunting activities.

Negative effects not directly related to tourism
The tourism industry should endeavour to keep abreast of, and lend support to, developments in research and conservation measures that affect wildlife, such as impacts of exotic animals, fire regimes and weed control.

5.2 Reducing Negative Impacts

The identification and monitoring of negative effects in not necessarily easy, and in order to do more than pay lip service to wildlife conservation issues, persons involved in both tourism and conservation need a certain level of skill and knowledge. Conservation managers, tour operators and interpretive guides should endeavor to keep abreast of available information on negative effects and take steps (such as those outlined in Sections 3 and 4 of this report, NEAP documentation and guidelines prepared by State government authorities) to minimise such effects. Employers should encourage – and facilitate – this learning process.

Choice of management actions initially requires consideration of the most appropriate elements to be managed. It also requires decisions about which of the following techniques – or combinations of techniques – are likely to be most effective, practicable and acceptable to users:

- Physical alterations to the natural environment are often useful to modify the intensity of use at particular times and places and the intensity of negative effects of each user.

- External regulation can be used to modify patterns of visitor use and behaviour, and is vital in cases where particularly vulnerable wildlife or habitats are involved. Its effectiveness is likely to be maximised when there is sound scientific research supporting the need for regulation, high levels of understanding and support from users (sometimes requiring education), and adequate systems of enforcement. Where other methods can be used to achieve adequate levels of impact mitigation, external regulation should be avoided because of the detrimental effect it may have on the perceptions and attitudes of visitors.

- Self-regulation by industry bodies and individual operators may be an effective way of influencing operator behaviour, but to be effective, measures such as accreditation probably need to be associated with enhanced business success, which in turn requires consumer recognition and support.

- Economic instruments seem to have considerable potential to influence behaviour and levels of usage by operators and visitors, and should be further investigated and implemented where practicable.

- Education of visitors and the tourism industry seems to be important in influencing behaviour, especially where there is widespread ignorance of potential negative effects. This should include incorporation of appropriate messages within advertising materials.

- Market research can be used to help determine appropriate management strategies.

- Appropriate targeting of promotional efforts should be used where necessary to influence levels of usage.

- Land managers should adopt measures to facilitate the use of environmentally responsible guides to help manage visitor behaviour, and promote the development of appropriate cooperative agreements with responsible operators.

Usually, a complementary mix of the above techniques will be optimal. The best mix in a particular situation will depend on a complex array of factors such as management objectives, other considerations such as visitor satisfaction, and the available funds, staff and other resources. There is a conspicuous need for further research to investigate the effectiveness of different management techniques, and how these vary between different situations.

- No matter what the scale at which it is applied, management of the potential negative effects of wildlife tourism on wildlife and their habitats should occur within a holistic framework. This should include clear definition of management objectives, appropriate management measures for mitigating these impacts, monitoring and formal documentation (see section 4.5 and 5.4 for details).

- There is a need for State conservation agencies to develop clear policies to guide management of hand-feeding, spotlighting, visitor access to sensitive areas, and other issues relating to effects of wildlife tourism on wildlife. Development of such policy should include consultation with wildlife ecologists and with rangers and wardens and others who are in a position to regularly observe the behaviour of wildlife tourists.

- Government agencies and large operators should consider adopting (and probably modifying for their use) processes such as VIMM, LAC or TOMM in the ongoing management process. They will need to include an adequate process for incorporation of the perspectives of various stakeholders and resolution of any associated conflicts. In addition, before considering whether to proceed with a development or activity that might have significant detrimental effects on wildlife, even if the EIA process is not triggered, operators and/or natural resource managers should adopt a comparable process.

- Objectives should include statements about the acceptable levels of negative effects on wildlife and habitats, in such a way that these can be translated into quantifiable measures that can be monitored. Defining these objectives will usually require consideration of other (sometimes conflicting) issues such as

visitor satisfaction, an assessment of the likely magnitude and importance of any negative effects, and consideration of what to do in the face of uncertainty about actual effects.

- In most cases, management should be targeted primarily at visitors and operators. Wildlife tourism activities and infrastructure should be carefully and creatively designed to incorporate features that will minimise negative effects on the wildlife. Where it is expected that high numbers of visitors in the vicinity of wildlife at certain times may cause a problem, measures to manage the numbers, spatial distribution and/or temporal distribution of visitors should be implemented. Where certain aspects of visitor behaviour may be associated with detrimental effects, measures to modify behaviour – either directly or through modifying their expectations and attitudes – should be implemented.

The following are recommendations relating specifically to some of the major management techniques.

Physical Alterations

- Various measures to harden the natural environment (and possibly the wildlife) should be employed in situations where the control of visitors is problematic (usually due to inadequacy of supervision and monitoring on site).

External regulation

- Species and habitats identified as being threatened or sensitive should not be available for tourism activities unless it can be demonstrated that the negative effects will be negligible.

- Where threats during critical periods (e.g. nesting) have been identified or are reasonably suspected for particular species, appropriate restriction of tourism activities during those periods should be enforced.

- Hand-feeding should not be allowed in protected areas or in other areas of extensive natural habitat except in a very few carefully-selected and regulated sites if it can be reasonably demonstrated that (a) no long-term ecological effects are likely to

ensue and that (b) the benefits accruing from enhanced appreciation of the animals and support for wildlife conservation are likely to outweigh the negative effects in any particular case. Hand-feeding in non-natural areas should follow strict guidelines and be carefully monitored to avoid negative effects.

- Recreational hunting and fishing should be carefully regulated to comply with both conservation and welfare aims. Regulation should make maximum use of current knowledge of animal ecology, behaviour and physiology. Managers, policy-makers and researchers should communicate regularly to pinpoint important knowledge gaps.

- Granting of commercial activities licenses should be based partly on evidence of adherence to adequate environmental management standards, and on positive contributions to conservation where there the demand exceeds the number of licenses allocated for a site. Queensland Parks and Wildlife Service is taking an important step in this direction by including a criterion regarding to contribution to conservation in allocation of capacity for newly available sites (Charters 2001).

- Appropriate penalties should be written into legislation in all States and territories for breaches of conduct by tourists or tourism operators, after consultation with conservation managers and wildlife ecologists to identify major needs. Serious breaches such as deliberate cruelty or the collection or destruction of plants and animals is covered by legislation, but this is not necessarily true for some other activities of concern.

- It can be extraordinarily difficult for the individual to find out precisely what the law dictates in the various States regarding conservation and animal welfare (for example the collection of molluscs on beaches outside of national parks, or the disturbance of animals for photographic opportunities), without laboriously poring through Acts of Parliament, an occupation few have sufficient time for accomplishing adequately. There is a need for a handbook, website or other readily-available document to inform tour operators, conservation managers and others on

existing legislation relating to tourism activities which could affect the conservation or welfare of wildlife .

- Existing legislation and bureaucracy needs to be examined for anomalies. There are times when a solution to a problem appears obvious but bureaucracy interferes with its application. In the case of the dolphins at Tin Can Bay (see 3.3.1), it would be easy to train the animals to visit a site 50 metres away around the corner from the present site and thus substantially decrease the degree of danger to both animals and children, but current bureaucratic problems are seemingly making this impossible.

Industry self-regulation and marketing

- Non-legislative measures should be put in place to give the competitive edge to tourism operators who 'do the right thing.' Progress is being made in this regard through cooperation between NEAP (Nature and Ecotourism Accreditation Program) assessors and government officials responsible for granting licenses for commercial tour operators in national parks and other reserves. A strong association between accreditation or environmental tourism awards and enhanced business success should be promoted by ensuring a high profile for the accreditation and what it means to tourists and travel agencies. Brochures, videos, television and other media should be employed to provide information and encourage tourists to choose operations that aim for minimal impact on wildlife.

Education

- Conservation authorities should endeavour to educate tourism authorities (initially in a very basic sense but hopefully with growing sophistication as research refines our knowledge) on the impacts on wildlife of tourism in general and wildlife tourism in particular, and suggest methods of minimising these impacts while still allowing appropriate and enjoyable tourism activities.

- Similarly, conservation authorities and knowledgeable tourism authorities should endeavour to educate travel agents and tour operators on such impacts and their mitigation. To some extent this is already happening with NEAP, but this does not reach wildlife tour operations that are outside the definition of

ecotourism or ecotour ventures that make no application for accreditation.

- Mechanisms should be set up to facilitate the discussion of problems between wildlife ecologists and tourism managers to resolve apparent conflicts. Compromises are often possible once problems on both sides are realised: e.g. instead of removing old trees which may drop limbs on walkers but are important to hole-nesting birds, walking trails could be redirected to enable their retention.

- There needs to be some communication to tourists and tour operators on why certain measures which could detract from a 'wilderness' experience may be necessary for the protection of wildlife and habitat. Sealed tracks for instance may be necessary to control erosion in well-used areas, or visitors to breeding colonies may need to be accompanied by a ranger.

Avoiding or curtailing development

Where biodiversity preservation is seriously threatened by a planned or current wildlife tourism development or activity, conservation should take precedence over demands from the tourism industry and the development should not proceed. This will be the case in the following situations:

- Where an environmental impact study or subsequent monitoring has identified a moderate to high conservation risk to threatened species or ecosystems, the tourism venture should not proceed unless development can be altered such that these concerns can be satisfactorily addressed.

- Where there is a high level of uncertainty about effects on threatened species the tourism venture should not proceed unless development can be altered such that these concerns can be satisfactorily addressed.

- In situations where a high conservation risk to local populations of non-threatened species is demonstrated, the development should not proceed unless it can be demonstrated that (a) the development can be altered to remove such risk, (b) the

population at risk is very abundant elsewhere, especially if its abundance has been increased by other human activity or habitat modification (for instant noisy miners) and (c) that a decrease in the local population is not likely to affect the rest of the ecosystem in any serious way.

All of the above, however, need to be considered in the context of what the likely alternate uses of the land on which the wildlife occurs might be, and whether the possible non-tourist use might put species at even higher risk. In some cases the use of adaptive management may be appropriate.

5.3 Increasing Positive Impacts

Although outside the scope of this report, it is important in order to put the present report in context to note that wildlife tourism can have positive effects on wildlife and habitats under some conditions (reviewed by Higginbottom *et al*. 2001b). The main mechanisms by which this can occur are through provision of: financial and non-financial contributions to conservation, socio-economic incentives for conservation, and education. All of these can in principle apply to both non-consumptive and consumptive forms of wildlife tourism. In certain rare cases, the killing of wildlife might also provide some direct conservation and animal welfare benefits. Thus, in order to maximise the net benefits – or minimise the net costs – of wildlife tourism to wildlife, we recommend that along with the measures proposed in this report, stakeholders also adopt measures to facilitate positive effects. This represents an exciting challenge for the wildlife tourism industry, with plenty of room for innovation. Recommendations to enhance the positive effects of wildlife tourism on wildlife and habitats are given by Higginbottom *et al*. (2001b).

5.4 Monitoring Programs

Monitoring which begins before the commencement or expansion of a wildlife tourism venture and continues regularly in at least two seasons is highly valuable (a) for the tourism operator's own knowledge base, (b) to check whether wildlife numbers or behaviour are changing in ways that suggest a modification of tourism activities is needed, and (c) to add to a general database to progressively

expand our knowledge of the reactions of Australian wildlife to various activities.

- It should become mandatory for new wildlife tourism ventures above a certain size (the magnitude of which will differ for different kinds of operation and habitat) or likely to involve threatened fauna, an Environmental Impact Assessment will commence in time for the collection of good baseline data on fauna and habitat on site before operations begin. The usual excuse – that time was not available to begin such studies months ahead – rarely holds, as other aspects of planning an operation (financial and engineering advice, application for permits etc.) begin well in advance of setting up. Assessments should involve testable predictions and subsequent quantitative monitoring that can (in time) be analysed statistically. Observations should be recorded in at least two seasons. Written or electronic records must be made of all relevant observations: it is difficult to recall after a few years (or even days or hours) which waterway the grebes were nesting in, or in which part of the valley the kangaroos were feeding. It is recognised that extensive baseline studies by trained ecologists are beyond the scope of most small operations, and it should be possible for some operations to use skilled amateur naturalists or perform the studies themselves if they can demonstrate suitable ability and experience.

- Results of baseline studies should be held in the libraries of State government conservation authorities. Periodic reviews of all available impact assessments (and where possible subsequent monitoring records) could then provide valuable guidelines to future planning. For scientific and environmental purposes it would be valuable for results to be made available for peer and public review. However:
    1. It is understandable that some operators would not wish their hard-won knowledge of the presence of wildlife in specific locations to be readily available to competitors;
    2. The ready access to such knowledge by the general public could lead to over-use by unsupervised visitors; and
    3. Operators may fear bad publicity if they are too honest about apparent impacts of their tours, whether this is likely to reach

the attention of actual customers, travel agencies or prize-awarding bodies, etc.

Hence, research and discussion with stakeholders is needed to find satisfactory procedures for restricting access to such files in a way which is fair to all participants.

- Clear, non-jargonised advice on monitoring techniques should be developed for conservation and tourism managers (including operators) for a variety of possible impacts on wildlife, perhaps incorporated into the manual recommended in Section 5.1. Such guidelines would ideally be prepared by experienced ecologists, in consultation with managers who could identify ambiguities in the wording and potential difficulties in the implementation. They should include a user-friendly explanation of the rationale behind the major requirements of a good monitoring program as outlined in Section 4.3.2. It is envisaged that guidelines could be provided online, initially for general usage over a broad range of conditions, but continually expanded (especially as research results become available) to include more specific advice on particular wildlife taxa, habitat-types and geographic regions.

Indicators of negative impacts on wildlife and their ecosystems

Ease of use or tourist interest are not sufficient criteria for selecting indicators of negative effects on wildlife. Numbers of kangaroos or koalas or the diversity of bird species for instance may fail to indicate heavy losses in biodiversity, especially amongst wildlife requiring shrubby understorey, hollow limbs or particular plant taxa, or those which are particularly disturbed by human activity. This topic is discussed more fully in Section 4.3.3.

- Further research is needed to suggest efficient monitoring techniques for a variety of situations. This includes research into indicators that really do indicate important factors but are relatively easy for non-professionals (or professionals with severe time constraints) to use. Results of this research should then be made widely available to tourism operators and conservation managers.

5.5 General Issues

- Systems needs to be set up (or enhanced where already existing) to facilitate improved communication on policy and management issues: (a) between and within conservation agencies in different States; (b) between authorities responsible for policy development and the rangers, wardens and other field workers in regular contact with wildlife tourists; and (c) between conservation agencies and tourism personnel.

- With tourism now being one of Australia's largest industries (providing large economic benefits to society at large), federal and State governments should increase levels of funding to State conservation agencies for monitoring, management, policy development and education of tourists and tour operators.

- Greater responsibility for sustainable management of natural resources on which tourism is based should be taken by the tourism industry. This could take the form of funding and/or direct involvement in management and monitoring, and should occur both at the level of individual operators and industry associations.

- State agencies and tertiary institutions (especially Cooperative Research Centres, which are intended to address transfer of information and ideas to public stakeholders) should actively promote the incorporation of adequate environmental management considerations into business plans for all wildlife tourism ventures.

- State conservation agencies should endeavour to find ways to provide incentives for tour operators to become involved in management and monitoring and to enhance their ability to do so. Various suggestions elsewhere in this section of the report are relevant here.

- State agencies and local councils should investigate possibilities for encouraging land-owners in wildlife tourism regions to conserve habitat on their properties, whether by tax incentives or

by facilitating a process whereby the land-owners are paid a fee by tour operators bringing tourists through their land (at present bureaucratic obstacles and lack of infrastructure for communication between operators and land-owners tend to inhibit this process).

- There needs to be a process of clear communication to tour operators and conservation managers as to who is responsible for various aspects of wildlife conservation (local council, State conservation agency, other State agency etc.) and in some cases there is also a need for re-thinking of this issue and guidelines on how to proceed when particular problems cut across bureaucratic boundaries (such as in the case of the dolphin mentioned in Section 3.3.1).

- A forum or process should be created whereby conservation and animal welfare issues can be simultaneously examined by governments.

- If funding for adequate assessment and monitoring of negative impacts is not available for operations likely to be of conservation concern, the operation should not be permitted to proceed until such time as such measures become possible. This applies to tourism on both public and private land, and is in line with the precautionary principle as outlined in Section 4.6. In the case of small operators starting out on a limited budget and faced with many expenses before receiving sufficient income on a new venture, a big incentive for complying with conservation measures would be financial assistance with impact assessment. This should be available only to those who demonstrate a commitment to wildlife conservation, and could be either in the form of a loan to be paid back as the operation becomes viable or a non-repayable subsidy towards paying environmental impact assessors.

- There is an urgent need to improve levels of skill in recognising, assessing and (particularly) monitoring of the negative effects on wildlife. One remedy for this lies in the manual suggested elsewhere in this section, but in-service and other courses need to be provided for tour operators, rangers, environmental impact assessors and others, as the complexity of the problems is often

not appreciated or adequately dealt with. Short courses should be set up by conservation agencies or tertiary institutions, possibly involving the internet in the case of those for whom travel would be prohibitively expensive or whose work it is impossible to leave for more than a day or two. Once again, if small tour operators in the setting-up stage can demonstrate a willingness to comply with conservation measures, a subsidising of such courses would provide an additional economic incentive to 'do the right thing.'

- In general, environmental issues should not be considered in isolation, but need to be balanced with consideration of host, economic, and visitor satisfaction issues. However, there are certain requirements of wildlife and biodiversity in general that should not be compromised.

- Further studies are needed on what various kinds of tourist really desire, and what restrictions or behavioural changes they would willingly accept for the sake of the wildlife and native ecosystems in general. We are not suggesting that conservation managers should be slaves to the wishes of tourists, but a clearer understanding of the needs of each might enable some changes to proceed more smoothly (see also Moscardo *et al*. 2001).

In conclusion

Sound decision making about whether a certain wildlife tourism venture should proceed or what management should be put in place requires: (a) recognition that there are few 'pat' answers and that different circumstances often require different solutions; (b) logical dissection of the different types of effects and an appreciation of the complexity and interaction of possible effects on wildlife and habitats, (c) recognition of conservation, animal welfare and ethical arguments; and, in some cases, (d) further research. Monitoring should form part of the management of all wildlife tourism ventures and activities. In circumstances where there is cause for concern about potential negative effects but wildlife tourism ventures are permitted to proceed or continue, it is especially vital that sound monitoring and management practices are in place. This is an area that requires further development, research, and commitment from management authorities. In particular, monitoring techniques that can readily be

used by resource managers and operators need to be developed and implemented. However, increases in such activities by resource managers would also require an increase in government funding. The potential for wildlife tourism to contribute to the burgeoning tourism industry in this country, coupled with the vulnerable nature of much of the wildlife and habitats on which it is based, will hopefully encourage such an increase in well-directed funding to ensure an on-going symbiosis of responsible wildlife tourism and nature conservation.

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Jeremy Thompson, Environmental Protection Authority, Queensland

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ACKNOWLEDGEMENTS

We gratefully acknowledge the time, information, suggestions and opinions given by the conservation authorities in State government agencies listed in Appendix A. Thanks are extended also to informants listed under personal communications, to Libby Small and Stuart Lennox, and to various other staff of government agencies, tourism operations and tertiary institutions who provided information and suggestions. We further thank the tour operators interviewed during an assessment of kangaroo tourism (Higginbottom *et al*. 2001c) which provided some insights relevant to the current document. A grateful acknowledgment is also extended to Chelsea Northrope, who has spent many long hours as research assistant seeking and compiling information and helping to prepare and proof-read the manuscript.

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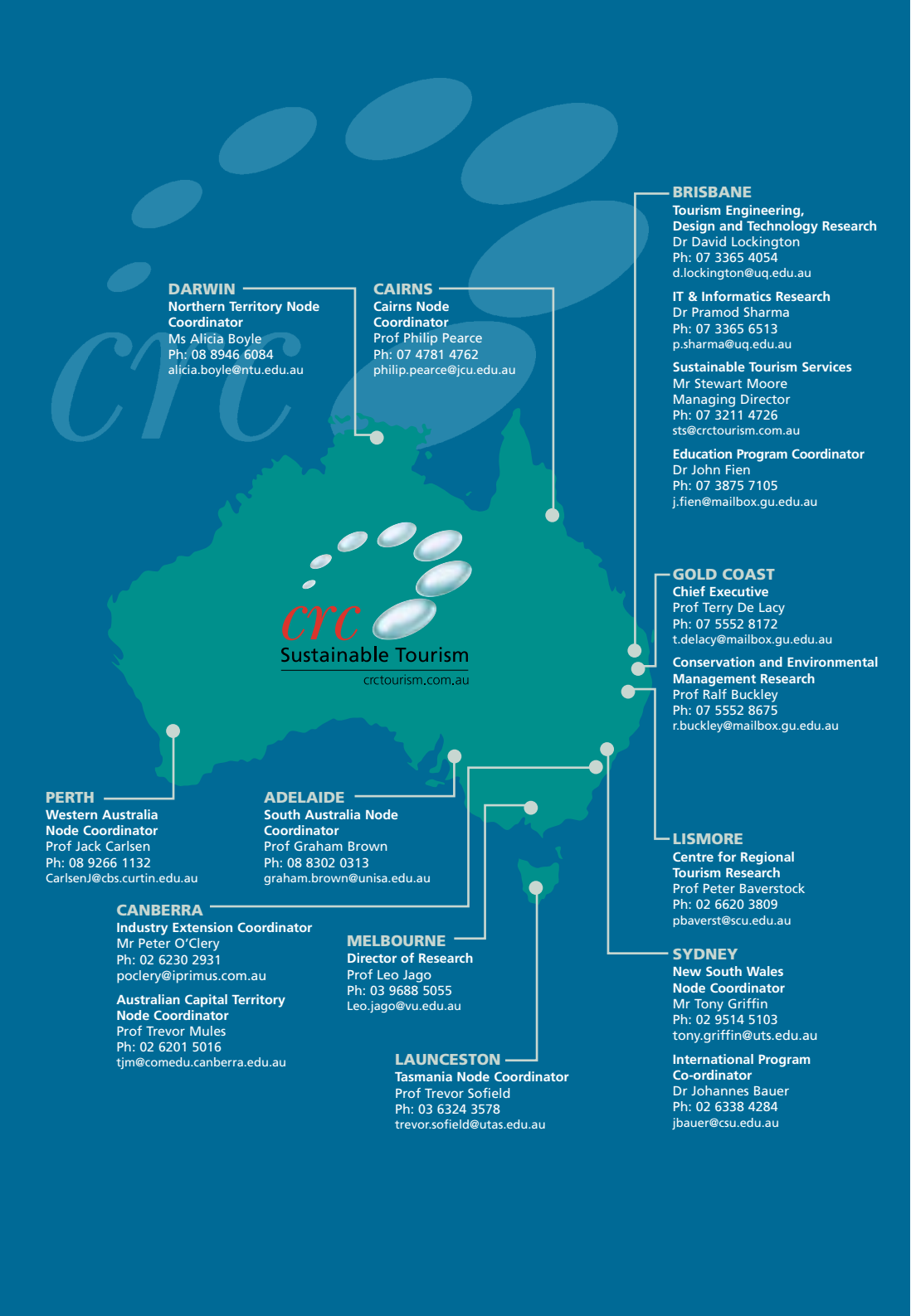

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