Bringing Science to Wildlife Tourism: The Influence of Managers' and Scientists' Perceptions

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Wildlife tourism is one of the fastest growing tourism sectors worldwide. Little is known, however, about its impacts on the wildlife on which it depends. This paper explores, as a first step in addressing this shortcoming, the perceptions held by tour operators, managers and wildlife scientists regarding the role and purpose of scientific research in sustainable wildlife tourism. The study drew on four case studies from Western Australia – two managed attractions and their managers and two wildlife tours and their operators – plus interviews with wildlife scientists. Key findings included a focus by scientists on the conservation biology of threatened species and the 'scientific method'. The influences of the 'scientific community' and 'being a scientist' on scientists were also apparent. Managers and operators, on the other hand, focused on the urgency of scientific knowledge for addressing potential impacts. A major challenge to progressing the scientific attention given to the impacts of tourists on wildlife is closing the perceptual gap between scientists and managers regarding the role and purpose of scientific research in this rapidly growing, dynamic and yet potentially sustainable industry.

Keywords: managers, perceptions, scientific research, scientists, sustainability, wildlife tourism

Introduction

Wildlife tourism, tourism based on encounters with non-domesticated animals in their natural environment or in captivity (Burns & Sofield, 1999; Higginbottom *et al.*, 2001), is becoming an increasingly important component of tourism worldwide (Roe *et al.*, 1997). In 1994 wildlife tourism accounted for 10% of all international tourism (Pleumarom, 1994), while in the United States alone, more than 62 million Americans participated in some form of wildlife viewing or nature tourism in 1996 – nearly one-third of all adults (Watchable Wildlife, 1999). Commercial whale watching is now estimated to be a $US1 billion industry worldwide and attracts more than 9 million participants a year (Hoyt, 2000). Bird watching, another form of wildlife tourism, is estimated to involve up to 60 million people worldwide, approximately 20–35% of the adult population (CRC ST, 2002).

For countries such as Australia, the presence of diverse and unusual wildlife is a major influence on visitors choosing Australia as a destination (CRC ST, undated). Hundloe and Hamilton (1997) estimated that the total annual value of wildlife to overseas tourism in this country was in the range of $US1.8–$3.5 billion. In Australia, over 600,000 people are believed to participate in

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dolphin and whale watching, generating more that $AUD8.9 million (CRC ST, 2002).

Not only is the wildlife tourism industry growing, there is also a growing number of tourists wanting close interactions with wildlife and their habitats (Duffus & Dearden, 1990; Reynolds & Braithwaite, 2001). Factors contributing to the interest in closer interactions and the overall growth of wildlife tourism include increased 'green' awareness and cheaper, faster access to destinations (Shackley, 1996). Also influential are increased disposable income and leisure and paid vacation time (Flather & Cordell, 1995). Eagles *et al.* (2002) noted that increasing social concerns about the quality of the natural environment, coinciding with higher educational levels, have contributed to the growth of general learning activities such as wildlife viewing.

This rapid growth has led to increasing concern about the impact on wildlife and their habitats as well as the industry's sustainability (Green & Higginbottom, 2001; Higginbottom *et al.*, 2001; Knight & Gutzwiller, 1995; Reynolds & Braithwaite, 2001). Consumptive wildlife tourism (i.e. hunting and fishing) is known to adversely affect the abundance, distribution, and demographics of wildlife populations through damaging or removing animals. However, non-consumptive wildlife tourism (i.e. based on viewing and interactions) can also have adverse effects, such as increased mortality, reduced productivity and displaced populations, even though the term does not imply this (Tremblay, 2001).

Independent of whether this form of tourism is consumptive or non-consumptive, impacts have been recognised from four main sources: exploitation, disturbance, habitat modification and pollution (Knight & Gutzwiller, 1995). Such impacts may be direct, including the death of animals, or indirect, for example damage to vegetation or soil erosion (Butler & Boyd, 2000; Roe *et al.*, 1997). The seriousness of negative impacts on wildlife can vary from mild discomfort or inconvenience to individual animals through to local or even global extinction of species. It is not easy to determine where a particular effect is likely to lie on this spectrum, as relatively minor stresses may be symptoms of, or cumulatively lead to, more serious problems (Green & Higginbottom, 2001). The vulnerability of the species concerned is also clearly an important factor as it is believed that certain species are likely to be more vulnerable, as well as impacts to wildlife being site- and species-specific (Higham, 1998).

One of the greatest benefits touted for forms of tourism such as wildlife tourism, nature tourism and ecotourism is their potential ability to be sustainable – economically, socially and environmentally (Boo, 1990; Braithwaite & Reynolds, 2002; Higginbottom, 1999; Newsome *et al.*, 2002). As in many other sectors, the practical and conceptual elements of sustainability for wildlife tourism and ecotourism are still evolving (Clarke, 1997). Eber (1992) emphasised that the tourism industry, similarly to other businesses, must recognise its responsibility to the environment and learn to become sustainable. Aspects of sustainability most relevant to wildlife tourism include economic and business viability, visitor satisfaction and education, and particularly relevant to this paper, the impacts of tourism on wildlife and habitats (Green & Higginbottom, 2001; Higginbottom *et al.*, 2001). Gilbert and Dodds

(1992) noted that for ecologically sustainable tourism activities, managers need scientific knowledge on which they can base their decisions.

Given this diversity of possible impacts and possible responses, plus concerns surrounding sustainability, it is essential that good scientific research is available to inform the management of wildlife tourism. This is not the case as Hodge (2002: 40) recently noted: 'There is scant scientific research into the direct impacts of tourism on wildlife'. Green and Higginbottom (2001) noted that little has been done to scientifically investigate impacts and how they can be monitored and managed. Documentation of existing scientific research in a form useful for managing wildlife tourism is also regarded as inadequate (Duffus & Dearden, 1990; Green & Higginbottom, 2000; Higginbottom, 1999; Higginbottom *et al.*, 2001; Lilieholm & Romney, 2000; Orams, 1999). To date, research has focused on the tourism experience and visitor satisfaction, visitor characteristics, carrying capacity and impacts on the natural environment and associated trade-off analyses (Reynolds & Braithwaite, 2001).

A wealth of reasons probably exists for this lack of scientific research into impacts. This paper explores one possible set of reasons – the perceptions of managers, tour operators and scientists involved in wildlife tourism, regarding the role and purpose of scientific research in this industry. By understanding these perceptions, those involved in wildlife tourism can identify, and then work to address, current barriers to engaging scientists in wildlife tourism research and assist managers to work more effectively with scientists. The desired outcome is improving the application and uptake of scientific research in relation to the potential impacts of tourists on wildlife and hence enhancing the sustainability of this industry. Given the significant overlap between wildlife tourism and ecotourism (Green & Higginbottom, 2001; Higginbottom & Hardy, 1999; Lilieholm & Romney, 2000; Newsome *et al.*, 2002; Reynolds & Braithwaite, 2001), the findings of this research also have relevance for sustainably managing the latter.

Methods

This study was conducted during 2001 in Western Australia (WA), the state occupying the western third of Australia, a country renowned for its wildlife and burgeoning ecotourism industry. Case studies of managed attractions and specialised tours, both forms of non-consumptive wildlife tourism, were chosen as in both forms close interaction with wildlife in natural surroundings is an integral part of the tourism experience, potentially leading to impacts on the wildlife. As the focus is often Australia's threatened wildlife, careful management is required (Green & Higginbottom, 2001; Higginbottom & Hardy, 1999; Lilieholm & Romney, 2000; Reynolds & Braithwaite, 2001). The four case studies were selected to cover the diversity of the managed attraction and specialised tour segments of the tourism industry (Table 1). As such, the cases include publicly and privately managed attractions, as well as threatened and more common wildlife.

A case study method (Yin, 1994) was used because it enabled a study of the perceptions of members of the contemporary tourism industry and wildlife scientists and helped address the research question guiding this study: 'What are the perceptions of those central to the wildlife tourism industry regarding

Table 1 Case study details

Case study	*Location*	*Size (ha)*	*Manager/operator*	*Wildlife of interest*	*Other comments*
Managed attractions					
Karakamia sanctuary	50 km northeast of Perth, WA's capital city, in the Darling range	225 ha of land surrounded by vermin-proof fencing	Privately owned and operated by Australian Wildlife Conservancy	Re-introductions of several native species including the woylie *Bettongia penicillata*, quenda *Isoodon obesulus*, and numbat *Myrmecobius fasciatus*, have been successfully achieved.	First Australian Wildlife Conservancy project initiated in 1991 and opened in 1994. Privately established and funded to protect threatened animals indigenous to area. Guided walks at dusk enable visitors to see marsupials in the wild.
Dryandra woodland	170 km southeast of Perth on western edge of wheatbelt and 22 km north-west of Narrogin	28,000 ha in 17 separate blocks	Managed by WA Department of Conservation and Land Management (CALM; state government)	Supports 13 species of native ground-dwelling mammals, including the threatened numbat, bilby *Macrotis lagotis*, and banded hare-wallaby *Lagostrophus fasciatus*. More than 100 bird species recorded, including malleefowl *Leipoa ocellata*.	Area renowned for its high nature conservation values. A series of walk cycle trails from one kilometre to 27 kilometres, plus a popular radio drive trail *Sounds of Dryandra Woodland*.
Specialised tours					
Yardie Creek tours	1200 km north of Perth in remote Pilbara region	N/A*	Privately owned and operated in CALM-managed Cape Range National Park under WA government lease	Threatened species such as the black-footed rock wallaby *Petrogale lateralis* and a wide variety of birdlife including the reef heron *Egetta sacra* and the osprey *Pandion haliaetus*.	Operate an hour-long boat tour up Yardie Creek Gorge with full Creek Gorge with full commentary focusing on wildlife.
Touch the Wild safari tours	450 km north of Perth in Midwest region	N/A*	Privately owned and operated across CALM-managed lands by Midwest local under WA government licence	Any wildlife that can be caught in Elliot traps, especially common reptile species (e.g. skinks such as *Ctenotus* spp., *Cryptobleharus* spp., and the bobtail *Tiliqua rugosa*).	Tours incorporate field-based fauna studies, in conjunction with CALM. Surveys are on CALM-managed reserves. The results are sent to the relevant authorities to provide baseline data for fauna management in the region.

*NA, not applicable.

the role and purpose of scientific research?' The unit of analysis (Yin, 1994) was the perceptions of those involved. Associated data collection methods included interviews, review of documentation and participant observation (Eisenhardt, 1989; Frankfort-Nachmias & Nachmias, 1996; Yin, 1994) (Table 2). A total of 15 in-depth interviews were conducted with managers of wildlife attractions, tour operators and scientists currently involved with these attractions. In addition, seven scientists involved in wildlife research but not in tourism were interviewed to gain their perspectives. Tour operators, managers and these 'independent' scientists were located through discussions with officers from the WA Department of Conservation and Land Management (CALM) responsible for licensing wildlife tourism operations. Snowball sampling (Frankfort-Nachmias & Nachmias, 1996), based on asking managers and tour operators for contact details, was used to locate scientists associated with the case studies selected.

Two sets of questions guided the interviews, one set for tour operators and managers of wildlife attractions, and the other for scientists. The tour operators' and managers' interviews began with general questions about their wildlife attraction or tour, covering the wildlife present, the level of interaction with tourists, and interviewees' sources of information for managing wildlife. The heart of these interviews then focused on scientific research, with questions about the current use of scientific research and its efficacy in relation to their tourism venture, additional research needs and their definitions of science. Each interview concluded with a question about the interviewee's professional background.

The questions guiding the scientists' interviews had some similarities and differences to the first set. Scientists were asked similar questions to the tour operators and managers: 'what scientific research in relation to wildlife tourism have they conducted, what have been its strengths and weaknesses, what additional research is needed, and what are their definitions of science?' This was also the heart of these interviews. Similarly, these interviews concluded with a question about the interviewee's professional background.

The questions associated with science, and the subsequent analysis, were tempered by recognition of the extensive current and past debates around the nature and practice of science (Lubchenco, 1998; Patterson & Williams, 1998). As a starting point for this study, however, science was acknowledged as both a social institution and a way of producing knowledge (Neuman, 2000). It is therefore both a system or set of cultural activities (Horwitz & Calver, 1998) for producing knowledge as well as the knowledge produced by that system. Rather than becoming submerged in this debate, this paper takes a constructionist approach (Berger & Luckmann, 1966), relying on the definitions and constructions of science provided by those interviewed.

The interviews were transcribed and analysed using a 'theory building' approach, for which case studies are particularly suited (Eisenhardt, 1989), the objective being to fully describe the range of perceptions present. Analysis was based on coding and re-coding the transcribed interviews to distinguish, describe and categorise these perceptions. Using this constructionist approach, codes 'emerged' from the data rather than being pre-determined prior to analysis. Codes are tools used to label, separate, compile and organise data

Table 2 Data collection details for case studies

Case study site	*Interviews with managers (M) or tour operators (T)*	*Interviews with 'industry scientists'*	*Interviews with independent scientists*	*Documents reviewed*	*Participant observation*
Managed attractions					
Karakamia sanctuary	2M	1	N/A*	Marketing material, management plans, newspaper/magazine articles	1 hour walk/drive around the sanctuary
Dryandra woodland	2M	2	N/A*	Management plans, marketing/interpretation material	2 hour walk/drive around the woodland
Specialised tours					
Yardie Creek tours	3M 1T	1	N/A*	Management plan, marketing material, brochures	1.5 hour boat cruise up Yardie Creek
Touch the Wild safaris	1M 1T	1	N/A*	Brochures, marketing material, newspaper articles	Overnight tour including trapping and releasing of wildlife
Independent scientists	N/A*	N/A*	7	Recommended wildlife tourism journal articles	N/A*
Total	**8M** **2T**	**5**	**7**	**N/A***	**N/A***

*NA, not applicable

(Strauss & Corbin, 1990). An example of a code emerging early in this study was 'knowledge of animal's ecology'. With re-coding, evidence was accumulated around an emerging and more complex theme about 'scientific research as a provider of scientific knowledge'. Through this approach, individual pieces of evidence begin to illustrate emerging themes such as that just described (Charmaz, 1983).

Pattern coding was the final analytic step for the interview-derived data. Such coding allows patterns and recurrences in data to be examined so that emerging themes can be fully described and differentiated (Miles & Huberman, 1994). The following results and discussion are organised around these themes, which together fully describe the perceptions of those interviewed and can be regarded as having 'built theory' about these perceptions. The results and discussion are presented together, a common approach taken in qualitative research to prevent duplication and repetition.

Coding, and subsequent pattern coding, are also influenced and informed by previous theory building (Strauss & Corbin, 1990). There is always a tension in this form of emergent 'theory building' between codes emerging from the data and being influenced by the researchers' reading and exposure to theoretical material. The analysis in this paper was influenced by ideas from the sociology of science and environmental management, in particular the work of Lynton Caldwell on the role of science in environmental impact assessment (Caldwell, 1982).

Documentation included management plans, marketing material and articles (Table 2). The documentation was not included in the coding process. Rather, it was used to describe the case studies and provide an understanding of the context within which the industries studied were operating. Participant observation involved visiting the attractions and accompanying the specialised tours. The resultant data were used for triangulation (Yin, 1994), to check that the results from the interviews were supported by the researchers' observations.

Results and Discussion

How managers and scientists perceived the role of science in sustainably managing wildlife tourism is described and discussed around four central themes: science as method, knowledge, communication, and as a profession. The pattern coding coalesced around these themes, three of which were recognised by Caldwell (1982), illustrating the interactive nature of coding as researchers move between their empirical data and previous research and theory building. The other theme, science as communication, emerged from the analysis, although again this area has been considered by others (Calver & King, 1999; Cullen, 1997; Ziman, 1984). Each theme is more fully described using the results of coding supported by interview excerpts. A particular focus is drawing out similarities and differences between managers and tour operators, and scientists.

It was apparent from the interviews that science was mainly considered in relation to the natural environment. Limited mention was made of it in relation to exploring the social sciences including the experiences of visitors either in their interactions with the natural environment and its wildlife or with each other. Science was discussed predominantly in the context of understanding the biology and ecology of wildlife and the associated natural environment, and the influences of tourists on these '...the sideline of that is the more animals you have the more tourists appreciate looking at these "furries" [marsupials], so the initial work is purely science and its secondary side effect is tourism'.

Science as method

Science was identified as an accepted method or process for acquiring knowledge by all of the scientists interviewed (Table 3). As one scientist commented: 'It is a process. It has to follow the accepted grounds of scientific methodology'. This methodology is widely described as a process of identifying a research question (with or without hypotheses), designing a study to address this question, collecting and analysing data, and then developing and seeking to answer new questions emerging from the findings (Neuman, 2000). An acceptance of this methodology implicitly underpinned the comments of all of the scientists interviewed, with its acceptance providing a common language for these scientists and their colleagues (Chalmers, 1982; Charlesworth, 1982).

For a number of scientists, recognising science as a method and having a common method for conducting science (from a modernist perspective) ensures the 'best' possible science is conducted. As one of the scientists noted: 'It's [science] how rigorous everyone here is about their technique, duplication, control...it's followed to the nth degree and so that it gets replicated, control, so the methodology is very good'. In this quote, the respondent is

Table 3 Respondent type and associated central themes

*Respondent category**	*Science as method (% of respondent category)*	*Science as knowledge (% of respondent category)*	*Science as communication (% of respondent category)*	*Science as occupation (% of respondent category)*
Land managers (n = 8)	25	100	100	12.5
Tour operators (n = 2)	0	100	100	0
Industry scientists (n = 5)	100	20	80	40
Independent scientists (n = 7)	100	57	86	57
All respondents (n = 22)	**64**	**68**	**91**	**32**

*Percentages for each respondent category may sum to >100% because individuals identified science as having more than one facet.

more narrowly defining the scientific method as prescribing control sites or individuals that do not experience the experimental 'treatments' as well as replicates of the treatments.

The scientific method as described by scientists in this study seems taken as given. It is accepted as the norm for scientific practice (Merton, 1973). It is very much a modernist perspective based on providing knowledge through a fairly linear, often largely deductive process. Horwitz and Calver (1998) suggested however, in relation to research evaluating the Regional Forest Agreement Process in Western Australia, that deliberation is needed about whether the methodology being used is appropriate or whether it is accepted (but not necessarily appropriate) because it is the norm. A similar view was expressed in this study with one scientist commenting:

> I think the methods are only as entrenched as people's acceptance of them. We as scientists, we think that we follow particular methodologies but what we're really doing is following societal momentum that gives us particular frameworks and thoughts.

Interestingly, when scientists were asked whether the scientific method fits with the way they conduct their research, faults such as being unrealistically simple and lack of fit with reality were identified: 'What it doesn't do is it doesn't have any of the feedback loops or change of direction that occur when you undertake research'. Another concern raised by the scientists was the inability to replicate experiments given that so much of the current wildlife research in Western Australia focuses on threatened species: 'Basically there was one population of numbats [threatened, small, ground-dwelling, termite-eating marsupial] to work on and you don't get a lot of replication through that…anyway, it wasn't the sort of result which you could defend statistically'. Replication is considered integral to the scientific method, as perceived by these scientists, as it enhances the validity of the research findings.

Little mention of the methods of science was made by managers and tour operators (Table 3). When they did, it was to express concerns about the lack of monitoring and results not being obtained or fed back to managers. In relation to monitoring, the following comment was made by one manager: 'We do very little monitoring and without monitoring you don't know if you have a problem or not a lot of the time'. Without monitoring managers are unable to assess the effects of past management decisions or the current impacts of tourism. Long-term monitoring is particularly important to separate out the impacts of tourism and other human-induced changes on threatened species from the potentially large fluctuations in population numbers that can occur across seasons and years (Anderson, 1991).

Results not being obtained by managers and operators were described as follows: 'A lot of the time we collect huge amounts of data and it doesn't get analysed or it doesn't get published or anything like that, I think that's a problem'. Because these results are not available to managers, they are unable to use them to guide their management. And, if the results do become available but only after the manager no longer needs them, then again the research is unlikely to be used.

Science as knowledge

All of the interviewed managers and tour operators believed that the importance of science was in providing scientific knowledge (Table 3). Most believed that science could be defined as knowledge, with one tour operator stating: 'I would define science as obtaining knowledge to provide answers to questions that you've got'. One manager referred to the dictionary definition 'I looked in the dictionary and it said knowledge'. The importance of science in constructing knowledge is a widely-held view, with scientific knowledge identified by modernists as knowledge proven through objective means (Chalmers, 1982). Postmodernists, on the other hand, have critiqued that knowledge can be objective instead drawing attention to its subjectivity. Of all those interviewed, including the industry and independent scientists, the majority highlighted the importance of objective, scientific knowledge in achieving sustainable wildlife tourism management.

Baseline biological information on the reproductive, dietary and habitat requirements of the wildlife of interest is regarded as necessary for their sustainable management (Buckley & Pannell, 1990). One of the managers commented: 'You need to know how these animals breed, how often they – how quickly they become sexually mature and able to breed, that's all part of the applied process of conservation'. In Australia, the introduction of foxes and cats by the first white settlers has led to 6.3% of the original mammal species being lost (Morton, 1990). These losses have instigated much of the current research to gain baseline information on threatened wildlife species (Burgman & Lindenmayer, 1998; Recher, 1990).

Most scientists interviewed stressed that their work was to obtain knowledge for conservation purposes not tourism, with some remarking that they play no role in wildlife tourism research, for example: 'I haven't been directly involved in wildlife tourism, it is not my field, my field's threatened species conservation'. However, Gilbert and Dodds (1992) noted that managers are using this information to manage wildlife tourism and its impacts. For the decision making process managers need knowledge on populations, birth and death rates, sex and age compositions along with other factors such as habitat quality, social interactions, and genetics which can all affect population changes (Gilbert & Dodds, 1992).

Both of the managed attractions have good baseline information on the wildlife of interest. Both Karakamia and Dryandra are focusing on increasing numbers and/or reintroducing threatened species to their attractions. Therefore their scientific knowledge in terms of reproductive, dietary and habitat requirements is highly developed. However, there is little scientific research on the direct and indirect impacts of tourism on the wildlife of interest and the associated environment.

In contrast, little scientific information is available on the wildlife that is the focus of the two specialised tours. It was also difficult to find scientists who were involved in scientific research relevant to these tours. When tour operators and managers were asked what scientific research they used one response was: 'From the point of view of how we look after the animals, there doesn't tend to be a lot of information on that aspect, and most of our management is just a "leave them alone" management'. A reason given for this lack of research and scientific knowledge was because these tours are not based on threatened wildlife with one manager commenting: 'I suppose a lot of the animals here are relatively common if you like'.

Examining the gaps in scientific knowledge, as identified by respondents, provides useful insights into what was regarded as the knowledge that science could help access. The lack of an interdisciplinary approach to gaining and communicating knowledge was identified as one respondent remarked: 'We need more people who are generalists and communicators who can look at the whole field and relate to other fields'. This need for inter- and trans-disciplinary research is being increasingly recognised as necessary to adequately address the complexities inherent in environmental management (Yorque *et al.*, 2002). As facets of environmental management, this need is also relevant to wildlife tourism and ecotourism.

Although for managed attractions good baseline information is available, two knowledge-related issues were raised by respondents. A recently emerging issue is lack of understanding of species interactions with a manager commenting: 'The population dynamics and the interaction between species; we are now seeing species living together for the first time for 50 or 100 years and they haven't really been studied together'. Here the respondent is referring to dramatic increases in the populations of several threatened mammal species in the same area following the removal of predators, and the associated lack of knowledge about interactions (Higginbottom & Hardy, 1999). Information will be needed on interactions within populations, between different species and with the natural environment in the absence of introduced predators (Gilbert & Dodds, 1992).

The other critical issue is using science to identify and minimise the negative impacts from tourism (Green & Higginbottom, 2001). There was a perceived need by respondents to move beyond gathering baseline information on threatened species and threatening processes, such as predation by feral animals (e.g. foxes, cats), to determining the effects of human-wildlife interactions on the wildlife and their environments. 'We're strong on translocation and cat and fox control…but there is very little that has been done on behavioural studies and the impact of people' commented one scientist. Researching impacts requires baseline knowledge of a species such as their life history parameters, habitat requirements, natural movements and social behaviour, overlaid by knowledge of their responses to tourism activities (Newsome *et al.*, 2002).

As mentioned, the wildlife of interest to specialised tours have received little research attention. Tour operators and associated managers specifically mentioned the need to gain enough of an understanding species' biology and ecology to minimise impacts from tourists (Gilbert & Dodds, 1992; Gray, 1999) and determining how to get the best interactions between tourists and wildlife. Illustrative quotes from managers follow: '…procuring scientific knowledge to be able to make better decisions in terms of the appropriate level of tourism activity' and '…trying to determine what is the best method of getting the best interaction between the wildlife and the tourist'.

Three main reasons from this research emerged as to why scientific knowledge is needed. The first is to provide information and support for decision-making. This idea is supported by CNIE (1994), Karczmarski (2000) and Miller (1993) who have all discussed the need for scientific knowledge in the decision-making process. In the past, management decisions about wildlife tourism have been based on factors other than scientific knowledge, as one manager commented: 'Some of those decisions made have been largely on gut feeling, experience, anecdotal evidence, rather than good strong scientific evidence'. Science can also provide access to a wider knowledge base, allowing a broader range of options to be identified.

The second reason also relates to decision-making, with scientific knowledge helping managers justify their decisions. Scientific information can help managers make well-informed, credible decisions (Gray, 1999; Horwitz & Calver, 1998) and to justify such decisions to their ministers and the public (Beckwith & Moore, 2001). The following interview excerpt illustrates this decision-making environment: '…in terms of justification and these days you have to be able to justify decisions more, you are far more accountable than you used to be in terms of day-to-day park management'.

Lastly, scientific knowledge is needed to develop informative and educative materials for wildlife tourists. Inclusion of such information is an essential as part of educating visitors and also enriching their experience. It is also a defining feature of ecotourism (Newsome *et al.*, 2002). Educating tourists was identified as very important by respondents with one scientist stating: 'Education has been of major importance, the more people appreciate biodiversity and the more people that support biodiversity conservation and pressure the politicians to spend money on it...' Indirect benefits of education and interpretation are increased public knowledge and therefore support (Meffe & Carroll, 1997).

Science as communication

Science can contribute to the sustainable management of wildlife tourism only if the findings are communicated to managers. Almost all interviewed believed that communication is a necessary component of any scientific research (Table 3), with one scientist commenting: 'My old professor…used to say, "no scientific work is completed until it's published"'. And almost all interviewed commented on the lack of communication associated with current research practices.

Many managers commented that scientists were not sharing their knowledge: 'We know there's lots of people out there doing work…but getting hold of that information is hard'. Scientists were aware of the need to improve communication with one scientist commenting: '…a lot of the guys here publish quite regularly in scientific journals but that still doesn't make its way out to the guy on the ground'. For scientists, communication is integral to peer review, one of the basic tenets of the practice of science. Peer review is used to ensure that the methods and findings can withstand scrutiny. Also, scientific research must be communicated to ensure its validity (Calver & King, 1999; Horwitz & Calver, 1998).

A number of those interviewed commented on the need for scientific findings to be communicated in everyday language that the general public, and managers and tour operators without a science background, could understand. One scientist noted that: '…one of our major weaknesses is actually getting the information, putting it into a form that most people can understand and then going and presenting it to the districts'. However, not all scientists may have an aptitude for communicating their findings in layman's terms (Calver & King, 1999; CNIE, 1994). As one scientist commented: 'it isn't good enough to have it in a scientific journal…but they [scientists] are not good at communicating in layman terms so they are not getting the message out'.

Publication, however, is only one form of information dissemination. Almost all interviewed believed that there needed to be other ways of scientists communicating their findings. Forums, conferences and seminars were raised as ways of exchanging information with one scientist commenting: 'the main problem is disseminating the information, lets have a barbeque, lets have a talk and we'll tell you what we're doing and why we're doing it'. There are also real benefits for the sustainable management of wildlife tourism to be gained from communicating scientific findings to this broader audience. Such communication can lead to increased support for conservation and biodiversity issues (CNIE, 1994; Jacobson, 1997; Wearing & Neil, 1999). One explanation given for why findings are not being communicated is the belief that the public would not be interested. However, this idea underestimates public awareness of conservation issues and the public's desire to learn (Meffe & Carroll, 1997).

A significant contributor to the concerns regarding communication can be attributed to the very different perceptions held by managers and scientists regarding the type of research scientists are conducting. Managers believe scientists are conducting pure scientific research while scientists believe they are doing applied research. As one manager commented: 'There doesn't tend to be a lot of applied science, there tends to be pure or fact-finding type of science and sometimes that makes it hard to translate'. And, an illustrative comment by a scientist: 'You look at science done in my department, it's 100% applied, we don't do science that is not in demand in terms of the application'. An outcome of this mismatch of intentions is managers believing that scientists are conducting research of no use.

Science as a profession

It was primarily the scientists (both independent and industry) interviewed who raised the idea of science as a profession (Table 3). A number of those interviewed identified that scientific research is done by scientists who are part of a broader profession or 'scientific community'. This community is loosely typified by sharing and openness through publication, an emphasis on peer review, and independence over the areas studied (Chalmers, 1982; Gibbons, 1985; Neuman, 2000). Peer review, conferences and publication of findings are widely recognised as ensuring credibility and preventing fraud in the scientific community, while allowing for methodologies to be examined and validated (Calver & King, 1999; Horwitz & Calver, 1998; Merton, 1973).

Within this broader community, how science is practised is influenced by institutional affiliations, allegiances, and obligations, which in turn creates constraints on what is funded, how experiments are conducted and what conclusions are reached (Horwitz & Calver, 1998). The following quote clearly illustrates how a scientist's affiliations influence the practice of science:

> So people enter this club...If you behave in particular ways, if you are able to convince the rest of this club that the work that you have performed conforms with their standard approaches and is communicated in a way that conforms with their standard communication practices then arguably you call it science.

Horwitz and Calver (1998) commented that scientists differ in their practices due to different institutional allegiances. A scientist's behaviour and way of conducting scientific research depends therefore on their present institutional allegiances as well as past allegiances, including where and in what disciplines they have trained. Wildlife tourism research was dismissed by several of the scientists interviewed: 'There's a lot of work to be done to promote better management in these areas [conservation] without worrying about tourism'.

A lack of independence in the type of research conducted was mentioned by several government scientists. In Western Australia, where most of the state's wildlife research is conducted by a Science division within CALM, research priorities are determined in large part by managers' needs. Departmental activities are organised and administered according to a 'purchaser-provider' model where managers, as the 'purchasers', decide what information they need and 'buy' it from the 'providers', including scientists within the Department. Scientists are therefore reliant in large part on funding from these purchasers who determine what research will be conducted:

> So this now gives the Director of Parks and Visitor Services the power to actually purchase services off [from] Science [Science Division within CALM] who are a provider ...and we in effect choose not to provide them [scientists] with any money if we choose.

This observation contradicts one of the features loosely typifying 'the scientific community', hence its mention with some concern by scientists. Interestingly, where scientific research was completely in-house, at Karakamia, there was no mention of lack of independence. This is surprising given the greater likelihood of research capture and lack of independence given the close working proximity of managers and scientists.

This reliance of departmentally based scientists on funding support from managers in their organisation suggests that the conduct of scientific research could come to depend on these managers' priorities. An outcome may be inattention to scientific research: 'The fact that we have people running the system who don't think that science is important, they don't think that doing research is important'. To further compound this problem, managers perceive a barrier between themselves and scientists. Scientists are often regarded as different and isolated from the rest of society (Mulkay, 1991).

Conclusions

This study has clearly highlighted the double bind in which wildlife tourism finds itself in relation to scientific research. Researching wildlife tourism, and specifically the impacts of visitors on wildlife and their environments, is not currently regarded as important by many wildlife scientists. Their focus is on getting a better understanding of the biology and management requirements of threatened species. They do not perceive themselves as contributing to managing wildlife tourism. Adding to this bind is many wildlife managers and tour operators regarding science, as currently conducted by scientists, as irrelevant and scientists themselves as being remote from the rest of society.

And yet, all of these parties recognise the mutually beneficial aspects of drawing science into wildlife tourism. Managers need scientific knowledge to justify and provide credibility for the management decisions they make. Even now, managers of wildlife attractions and tour operators are using scientific research on the conservation biology of species of interest, unbeknown to the scientists conducting in the research. Scientists need the support of managers, especially when they are part of government departments or companies (such as the Australian Wildlife Conservancy) where managers decide what and how much research is funded.

A significant hurdle to gaining these mutual benefits is problems in communication at a number of levels. At the most fundamental level, managers and tour operators, and scientists see the way that scientists conduct research very differently. Managers believe scientists are conducting pure research while scientists regard their work as very applied. Overlaying this fundamental difference is concerns regarding scientists not disseminating their findings and then when they do, them being unintelligible to the majority of managers and lay people.

Improving communication is a central issue. This issue has been raised in numerous environmental forums, it is not restricted to wildlife tourism (CNIE, 1994). It is very clear from this study that fundamental differences in how science and its role are perceived exist between managers and scientists. Developing some sort of shared understanding and agreement on the value and purpose of scientific research is a crucial first step. Such understanding depends on fostering relationships over time so that these understanding can develop (Moore & Lee, 1998). Means of doing this include holding forums that bring managers and scientists together, managers and scientists jointly designing and executing research projects, and establishing cooperative research centres that formally bring together managers, operators and scientists to fund and support research (DEST, 2002).

Jointly conducting research seems a large part of the answer to these communication issues. Such an approach can assist in ensuring the relevance of the research to managers' needs as well as ensuring managers have realistic expectations regarding the research outcomes. Challenges remain, however, in making findings available in places and forms accessed by managers and ensuring that the language and style are accessible to managers. Several promising approaches to overcoming these concerns are becoming commonplace – science agencies employing communication experts and fundors of research requiring (and funding) a final communication or 'diffusion' component as the endpoint of the research. Another worthwhile approach that does not appear to be widespread, at least in Australia, is providing scientific refresher courses for managers and operators so they can better understand scientific findings when they receive them from scientists.

Another part of overcoming the problems with communication is scientists recognising that managers want information – they are predominantly interested in science as knowledge. They have little interest or even awareness of science as a method or as a profession. Therefore, to get support from managers and make their science relevant, scientists must find out what information managers want and just as importantly, what do they want to use the information for. The final concern is then providing this information in a form that can be easily understood and used.

An important part of narrowing the perception gap between managers and scientists is assisting managers to recognise the nature of science as a profession and the associated demands including methodological ones. The profession has its own rewards, status and funding. It is apparent from this study, that rewards (i.e. funding, promotion, publishing, professional status) are based on conducting research in certain areas (i.e. threatened species conservation biology), in certain ways (i.e. 'pure' research), funded from sources that recognise and reward these areas and ways of doing research. The challenge for those interested in enhancing the role of science in wildlife tourism is to work with scientists, fundors, journal editors and reviewers, and science administrators to broaden the perception of what this profession might include and what scientists might be rewarded for.

In conclusion, the challenge of enhancing the role of science in sustainably managing wildlife tourism can be addressed on four fronts: science as method, knowledge, communication and as a profession. On each front, managers and scientists have very different perceptions and expectations regarding the role of science in managing wildlife tourism. Without understanding and bridging these differences the chances of improving the contributions of science to wildlife tourism remain poor.

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