Developing the marine mammal viewing industry: An integrated framework to address issues of long-term sustainability

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Introduction

Interactions between tourists and wild animal populations are associated with a range of impacts that are not well understood, and consequently even less well managed (Shackley, 2001). Such interactions have, rather belatedly, become acknowledged for their complexity (Duffus and Dearden, 1990; Higham, 1998; Lusseau and Higham, 2004). The case is arguably most pressing where tourists seek engagements with cetaceans (e.g., see Bejder et al., 1999; Bejder et al, 2006; Constantine, 2001; Corkeron, 2004; Gill et al. 2001; Lusseau, 2003; Williams at al., 2002). Whale and dolphin-watching has, over the last two decades, been in the vanguard of wildlife-based tourism experiences, recording phenomenal growth from a marginal activity in the 1980s to a billion dollar industry (estimated in 2000 to be worth $US 1,049 million), involving over nine million visitors, in little more than ten years (Hoyt, 2001). It is fortunate that with this phenomenal growth in visitor interest has come some concerted scholarly effort aimed at understanding the likely impacts of tourist interactions with cetaceans, and the management initiatives that are required to mitigate those impacts (Bejder et al., 2006).

This paper begins by establishing the theoretical and empirical contexts informing our current understanding of the impacts of boat-based tourist interactions with cetaceans. First, the conceptual framework provided by Duffus and Dearden (1990) is introduced as a platform upon which to discuss the management of the impacts of tourism upon populations of wild animals. Recent empirical research, including the work of Bejder *et al.* (2006) and Lusseau (2004) at Shark Bay (Western Australia) and Doubtful Sound (New Zealand) respectively, is then briefly reviewed. These conceptual and empirical platforms serve as a basis upon which to then propose a framework to inform the integrated management of tourism where visitors and wild populations of marine mammals are brought into close proximity. The proposed management framework is then discussed in terms of the integration of four key stakeholder groups; the commercial tourism operator, the research community (both natural and social scientists), policy-makers and management agencies. In discussing this management framework it is concluded that given the critical contribution of science to sustainability (Rodger et al., 2007), rigorous research and comprehensive monitoring must become an integral part of sustainable management.

The conceptual platform

Growing demand for wildlife tourism has created the need to understand the complex interactions of tourists and wildlife. The conceptual platform for this paper is provided by Duffus and Dearden (1990) who identify the dynamic nature of any form of tourism that involves the engagement of visitors with wildlife. They state that non-consumptive wildlife tourism resources *"exhibit evolution and change in terms of the nature of the users and the sites where the activity takes place"*. The dynamics of wildlife tourism are illustrated by Duffus and Dearden (1990) employing a tourist typology (expert-novice) in combination with the Limits of Acceptable Change (LAC) management planning framework (Figure 1).

Their conceptualisation postulates that wildlife tourism sites, like commercial products, tourism destinations (Butler, 1980) and animal populations (Higham and Lusseau, 2007), evolve dynamically over time (Duffus and Deardren, 1990). Thus, after a period of slow growth (Figure 1, A), visitor numbers often undergo a phase transition of rapid growth (Figure 1, B) to reach an equilibrium (Figure 1, C), (Duffus and Deardren, 1990). All tourist destinations and visitor attractions try to achieve sustainability by maintaining visitor numbers close to its carrying capacity. In tourism the likelihood that sustainability will be achieved is related to many extrinsic and intrinsic factors such as economic viability, competition and the sustainability of the resources upon which the system relies. So, for example, whalewatching relies on whales as the primary source attracting visitors. However, other factors such as fishing, whaling and pollution can affect the number of whales present at a tourism site. Duffus and Dearden (1990) presents scenarios under which the evolution of a wildlife site can interact with human activities, namely tourism, in terms of decline (Figure 1, C) and rejuvenation (Figure 1, E).

Insert Figure 1. Duffus and Dearden's (1990) conceptual framework for non-consumptive wildlife tourism.

There are a number of key elements of this conceptual framework. First, the profile of the user group typically evolves over time. This may be a consequence of growth in publicity and/or the development of facilities at the site. The expert-novice continuum suggests that the characteristics of tourists visiting a specific wildlife setting change over time. In the formative years exploratory visitors or ‘specialists’ tend to visit the wildlife setting. These tourists are generally few in number and high in previous experience and knowledge. They place little pressure on the ecology of the setting or the social system of the host community. They are motivated by a genuine interest in wildlife and conduct themselves in a manner that is consistent with minimising visitor impacts upon the focal species.

With increasing awareness of the attraction, the number and characteristics of the visitor mix evolves. A less ambitious or ‘generalist’ visitor profile emerges. *“There will be a concomitant demand for more facility development, more mediation and increased pressure on both the social system and the ecosystem of the host area”* (Duffus and Dearden, 1990). Specialists and generalists will be drawn into conflict as they compete for a limited resource. Due to a lack of genuine interest, the provision of information for generalist visitors becomes introductory rather than supplementary. In catering for wildlife generalists the appeal of the attraction to wildlife specialists will be compromised. Of equal concern to site managers, however, is the fact that any evolution of visitor profile is likely to also hold implications for the wildlife resource itself (Duffus and Dearden, 1990).

The second aspect of Duffus and Dearden’s conceptual framework addresses this probability. They employ the Limits of Acceptable Change (LAC) management planning framework to illustrate that an evolving visitor profile is unlikely to take place in the absence of impact upon the wildlife setting. Increasing numbers, the development of facilities and the evolving visitor profile may have significant ramifications for the focal species and the ecology of the site generally. This framework points clearly to the need for longitudinal research and monitoring of wildlife tourism resources. Thus Duffus and Dearden (1990) highlight three key elements of the wildlife-tourist interaction:

1. Site visitors
2. The focal wildlife population
3. The wider ecology of the wildlife tourism setting

This conceptual framework has been researched and upheld empirically (Higham, 1998). The growth in demand for visitor experiences over time as outlined in Duffus and Dearden’s framework closely mirrors this development of whale-watching since the 1980s (Hoyt, 2001). The following integrated management framework is based upon the recognised need for sustainable management of tourist interactions with populations of wild animals, and the conceptual framework provided by Duffus and Dearden (1990).

The empirical platform

Investigations of anthropogenic disturbance often must generate time-sensitive information under crisis conditions. However, investigators regularly fend off issues of scale, both in time and space, problems in research design and a lack of baseline data for comparative analysis. Studies evaluating the effects of human activity on wildlife typically emphasize short-term behavioural responses, from which it is difficult to infer biological significance or formulate plans to mitigate harmful impacts (Bejder et al., 2006).

Fortunately, the bottlenose dolphin population of Shark Bay is one of the best-studied cetacean populations in the world. At this location dolphin research commenced in 1984, nine years prior to the advent of vessel-based dolphin-watching in the area. Specifically, data were available both before and during vessel-based dolphin-watch tourism and at two tourism levels; and there existed identifiable subsets of the population with very different levels of encounter with tour vessels - hence providing before/after and control/impact comparisons. This allowed for the documentation of long-term responses to an expanding dolphin-watch tourism industry in the area.

Based on over two decades of detailed behavioural records, dolphin abundance was compared within adjacent 36-km^2 tourism and control sites, over three consecutive 4.5-year periods wherein research activity was relatively constant but tourism levels increased from zero, to one, to two dolphin-watch operators. When comparing periods of no-tourism and one-operator within the tourism site, there was no change in dolphin abundance per km^2; however, as tour operators increased to two, there was a significant average decline of 14.9% in dolphins per km^2, approximating a decline of one per seven individuals. Concurrently, within the control site, there was a non-significant average increase of 8.5% in dolphins per km^2. While acknowledging that research vessels are likely to have contributed to documented effects, it was concluded that, given the substantially greater presence and proximity to dolphins by tour vessels relative to research vessels, tour vessel activity was identified as the more significant contributor to declining dolphin numbers within the tourism site (Bejder 2005; Bejder et al., 2006a, 2006b).

The local decline was not part of an overall population decline because an opposite trend occurred in the adjacent non-tourism site, and the local decline was not explained by ecological factors, which would have had equivalent effects in the adjacent control site. Possible between-site differences in immigration or mortality could not be discounted, and differential recruitment via reproduction is under investigation. Specifically, analyses indicate that the female dolphins with high exposure to tour vessels are less successful at reproducing compared to the lower-exposed females (Bejder, 2005). Although this trend would not jeopardize the large, genetically diverse Shark Bay dolphin population, the decline in dolphin abundance and decreased reproductive success of exposed females was deemed unlikely to be sustainable for local dolphin tourism.

Similarly insightful research findings were achieved at Doubtful Sound (Lusseau, 2004). the second largest of the fourteen fjords that compose the Fiordland region in south-western. New Zealand. It is home to a small resident population of bottlenose dolphins (*Tursiops* spp.) that rarely leave the fjord for more than a few hours (Williams et al. 1993; Schneider 1999; Lusseau et al. 2002). Scenic cruises operate on this fjord, which rely significantly on bottlenose dolphins as a key natural resource (Lusseau 2002). The tourism pressure in Doubtful Sound has dramatically increased over the past two years (Lusseau 2002) and is planned to increase further in the near future. This expansion and intensification of anthropogenic pressure on Doubtful Sound, and consequently on the bottlenose dolphin population, has raised concern and heightened the need for management responses aimed at impact mitigation.

Monitoring the respiration rate of individuals can help in understanding the physiological constraints they are faced with since this physiological parameter is directly linked to metabolic demands. We followed individuals and recorded the time elapsed between surfacings with and without boats present as well as depending on the behaviour of boats (whether the boats violated the New Zealand Marine Mammal Protection Regulations). We observed typical vertical avoidance during interactions with boats and regulation violations had an additive effect for females (Lusseau, 2003). The more violations were committed during an interaction, the greater the increase in dive interval for females. By contrast males were not as affected by violations.

Moreover, the effect on females was substantial with an 18.6% increase in dive interval when one violation occurred, and 37.1% increase for more than one violation. Following predator avoidance strategy theory, we concluded that the observed extra energetic demand on females, related to their metabolic rate and smaller size, prevented them from vertically avoiding a perceived threat Howland, 1974). They would have therefore only increased their dive interval when necessary, i.e. when the threat is real (e.g. risk of injuries for example) during intrusive interactions. Males would have more energy available to avoid any potential problem via short-term vertical avoidance. This showed that responses to boat interactions had a significant biological cost that may be difficult to be met by females. Having to meet this cost could result in reduced reproductive success for females (Moberg & Mench, 2000).

In both fiords the behavioural budget of dolphins changed significantly during boat interactions in a similar fashion (Lusseau, 2004). These interactions disrupted significantly the dolphins' resting behaviour and increased the amount of time they spent travelling, to horizontally avoid boats. These changes did not alter the overall

behavioural budget of the populations because schools of dolphins did not spend enough time exposed to boats. However, comparing both fiords showed that this short term behavioural disruption strategy was no longer advantageous if there was typically less than 68 minutes between two boat interactions. Beyond this threshold the time elapsed between two boat interactions was no longer directly related to the number of boat trips undertaken but remained constant.

This shows that dolphins actively avoided boat interactions in order not to exceed this interaction frequency threshold. In order for the behavioural budget of dolphins, and consequently their energetic budget, to not change significantly, dolphins switched to long-term area avoidance when boat interactions were too frequent (Lusseau, 2004, 2005a). Boat interactions affect the ecology of Fiordland bottlenose dolphin populations This long-term area avoidance strategy resulted in the displacement of dolphins from their habitat; dolphins avoiding altogether the fiord when boating intensity was high (Lusseau, 2005). This meant that the dolphins spent significantly less time in Milford Sound during peak tourism seasons and their residency pattern was significantly negatively related to boat traffic. When dolphins visited Milford Sound they also avoided being inside the fiord, i.e. where boats cruised, during peaks in traffic. The likelihood that they would be found inside the fiord when present in Milford Sound was also significantly negatively related to boat traffic.

Two key conclusions emerge from these studies, and a number of similar studies (e.g., Constantine et al., 2004). The two case studies provide remarkably similar conclusions in terms of thresholds of tourism activity being breached and significant impacts resulting in need for careful and *effective* management.

An integrated management framework

The proposed management framework proposes the integration of four key stakeholder groups; the commercial tourism operator, the research community (both natural and social scientists), policy-makers and management agencies (Figure 2). The framework places the initial onus on policy-makers and management agencies to effectively establish the legislative context to oversee tourist engagements with marine mammals. This is likely to require the designation of marine protected areas (MPAs), or to otherwise ensure that regulations are enforceable, a notable weakness in management systems in many parts of the world (e.g., Samuels and Bejder 2004). The legislative framework should allow management agencies to develop a licensing system which should provide guidance on the limitation of permits and permit conditions including timeframe/s for permit review. Management agencies must withhold the right to revoke permits if deemed necessary.

Insert Figure 2. Model for managing the commercial development of wildlife tourism interactions with marine mammals

The pre-tourism phase

It is proposed that at this pre-tourism stage some essential baseline data should be the focus of initial researcher effort. In the natural sciences it is critical that pre-tourism data is collected to establish baselines for continuing analysis. Biological scientists should be engaged to establish what data should be collected in the pre-tourism phase prior to data collection beginning. It is also critical that biological scientists establish monitoring criteria for the focal animal population, as well as other species in the wider ecology of the wildlife/tourism setting. Before commencing baseline studies it is necessary to establish what baseline data is needed. This might include population estimates, population structure, reproductive rates and behaviour budget. Data collection should allow the analysis of key variables to provide an understanding of such things as breeding seasons and spatial ecology (Lusseau and Higham, 2004). In establishing baseline data collection and monitoring criteria it is necessary to ask ‘what is needed to have an adequate understanding of the local population of animals’?

Part of the process of establishing a monitoring programme must be consideration and delineation of an appropriate control site which should be entirely free of anthropogenic influence related to tourism. Thus, the control site must be considered in relation to the permitted spatial range of the commercial venture. In addition to the location or range (in the case of mobile air or boat-based operations) of the viewing facility, the acoustic range of visitors and machinery (as well as other forms of population) must be considered in the delineation of the control site (Lusseau, in press). It may also be prudent for biologists to establish key indicators in two categories. The first may be termed warning indicators which include, for example, changes in breathing intervals which may be an early sign of impact relating to tourism operations. The second, which may be termed

'show stoppers' are those that provide immediate evidence of significant impact. These might include evidence of decline in reproductive success within the focal population.

Simultaneously in the pre-tourism phase it is important that social science is engaged to investigate community support for a proposed tourism venture, and conditions upon that support. For example Findlay's (1997) study of land-based tourists viewing Southern Right Whales (*Eubalaena australis)* in Hermanus (South Africa) revealed resident support for land-based whale watching, and opposition to the development of boat-based whale watching due to concerns regarding whale disturbance. Such viewpoints should be understood and incorporated into management practice wherever possible. Where whale watch ventures become operational, the focus of social science research should initiate data collection to allow the analysis of visitor profiles (including the levels of expertise of visitors), incorporating dimensions of visitor satisfaction to inform the ongoing management of visitor operations.

Baseline data should inform management agencies in the establishment of appropriate LAC criteria, as conceptualised by Duffus and Dearden (1990). LAC criteria must be measurable and accountable in the monitoring programme. Quantifiable limits of acceptable change may be based on such variables as population numbers, animal fatalities, reproductive rates and demonstrated changes in the behavioural budget of the focal population (Bejder et al., 2006; Lusseau, 2004). All of these variables should inform the management agency in its deliberations of operator guidelines. This should include consideration of reasonable and appropriate limits on numbers of operator permits, the spatial range of operations, temporal range (season of operation, numbers of tours, contact time with focal animals), boat design (including appropriate levels of engine noise) and guidelines on approach speed and direction.

Having established operator guidelines the management agencies will be appropriately placed to issue one or more operator permits. In doing so it is typically the case that permits outline operator requirements to provide interpretation and visitor education programmes to those participating on tours. Additionally, all aspects of operation, as clearly informed by carefully considered operator guidelines, including the expiry date of the permit, should be clearly stated in all permits issued. The processes for monitoring permit conditions, permit review and, if deemed necessary, the revoking of permits, should also be clearly outlined. These processes collectively comprise the pre-tourism phase. Only when all of the step have been negotiated should commercial tourism operations begin.

Tourism phase

With the inauguration of a new tourism venture (or, where commercial tourism already exists, following the issuing of additional operator permits) comes continuing social science research needs. Visitor profiling should be undertaken to ascertain whether the target market is being reached, and to allow an understanding of the 'expertise' of visitors, given that the 'expert-novice' status of visitors has a considerable bearing on many aspects of visitor management (Duffus and Dearden, 1990). Visitor data should be collected on an ongoing basis to ascertain dimensions of visitor satisfaction, including elements of social carrying capacity. Studies may also be engaged to understand visitor perceptions of their wildlife experiences, including perceptions of environmental performance and impact perceptions. The effectiveness of environmental education programmes, perhaps extending to the extent to which the environmental values of visitors are challenged by the education programmes that they experience, may also inform the management of visitor operations. Regular reporting on the visitor operation should take place. The results of visitor research should inform modifications to commercial operations as they relate to the visitor experience.

The science programme associated with the animals that are the focus of tourist attention obviously continues into the tourism phase. Any changes to the operational environment, such as changes to permit conditions or the issuing of additional permits, should herald a new phase in data collection. Regular research and monitoring reports should, once again, be submitted to the management agency allowing analysis and responses to research outcomes. These research reports must serve as the basis of active and ongoing management decisions. They should inform the regular review of permits, resulting if necessary in revised permit conditions or the revoking of permits. Furthermore, they may serve as the basis for the regular review of MPA designations, changes relating to the management regime and possibly marine mammal protection legislation. Lusseau (2004), for example, notes that New Zealand's Marine Mammals Protection Act (1988) was effective at the time that it was enacted, but is now dated and ineffective. Enforcement is the critical determinant of effectiveness. The international context is replete with examples of legislation being in place, while breaches of regulations go un-enforced (e.g., Samuels and Bejder 2004). All of these processes should be ongoing, such that research, analysis

and reporting informs both active and evolving management decisions and the modification of commercial operations. Both must be responsive to good research in the natural and social science disciplines.

This integrated management framework gives emphasis to the critical role of research to inform managers on critical elements of sustainability. This point of emphasis responds to growing recognition of the role of science in achieving sustainability. In their study of wildlife tours in Australia Rodger et al. (2007) specifically address the place of science and monitoring in wildlife tourism businesses. Their recent results demonstrate low levels of engagement of scientists in protecting the wildlife of interest to tours. They conclude that "given the centrality of science to sustainability, mechanisms for increasing this involvement particularly in impact research, through partnerships and other means, are critical for the long term sustainability of this industry" (Rodger et al., 2007: 160).

Conclusion

This paper responds to established conceptual and empirical platforms informing sustainable tourist interactions with cetaceans in the wild. The conceptual foundation for this paper is provided by Duffus and Dearden (1990). Their theoretical framework highlights the complex and dynamic nature of any form of tourism that involves the engagement of visitors with wildlife. They theorise that the sites where tourist-wildlife interactions take place evolve over time. Thus, after a period of slow growth visitor numbers often undergo a phase transition of rapid growth to reach an equilibrium (Duffus and Deardren, 1990). If a state of equilibrium fails then the tourism site is likely to go into decline. There are a number of key elements of this conceptual framework which should be the subject of systematic programmes of empirical research. These elements include the profile of the user group which is implicated in the responses of visitors to information, interpretation and education resources, as well as manifestations of visitor behaviour. Evolution of the visitor profile may have significant implications for the wildlife resource itself (Duffus and Dearden, 1990). These elements of the visitor profile bears direct relevance to facilities developments as well as visitor impacts upon focal animals and site ecology.

In terms of the empirical platform it has been noted that at Shark Bay the dolphin-watching tourism industry is small-scale, licensed and controlled, yet measurable impact over a relatively brief period has been documented (Bejder et al., 2006). This provides an ominous warning for the numerous high-level tourism sites around the world; clearly cetacean-based tourism may not be as low-impact as previously presumed. Furthermore, in the absence of close visitor management small, closed, resident, or endangered cetacean populations are particularly vulnerable to the impacts of tourist interactions. Lusseau's (2003, 2004) research focuses on such a population; the bottlenose dolphin population in Doubtful Sound (New Zealand) is small and genetically isolated. Lusseau (2004) reports changes in animal behaviour based on the presence or absence of vessels, with the navigation of boats (and particularly violations of New Zealand's Marine Mammal Protection Regulations), being a critical factor. His work demonstrates that responses to boat interactions had a significant biological cost that may be difficult to be met by females, with a likely consequence being reduced female reproductive success (Moberg & Mench, 2000).

The integrated management framework presented in this paper is built upon these conceptual and empirical platforms. It emphasises the role of research in providing a thorough understanding of the interface between the social and natural dimensions of tourist engagements with cetaceans in the wild. However, it should be noted that this management framework need not be specific to marine mammals, but rather could be generalised to suit any wildlife tourism development content. The principles underpinning the framework are universal. It is hoped that the practical application of this framework may assist in advancing management practice in the direction of sustainability.

References

Bejder, L. 2005. Linking short and long term effects of nature-based tourism on cetaceans. Ph.D. thesis, Dalhousie University.

Bejder, L., Dawson, S.M. & Harraway, J.A. 1999. Responses by Hector's dolphins to boats and swimmers in Porpoise Bay, New Zealand. *Marine Mammal Science*. 15(3): 738-750.

Bejder, L., Samuels, A., Whitehead, H., Gales, N., Mann, J., Connor, R., Heithaus, M., Watson-Capps, J. and Flaherty, C. 2006a. Decline in relative abundance of bottlenose dolphins (Tursiops sp.) exposed to long-term

disturbance. *Getting real about wildlife tourism.* Proceedings, 2nd National Wildlife Tourism Conference. Fremantle, Western Australia. 13-15 August 2006. p. 30.

Bejder, L., Samuels, A., Whitehead, H., Gales, N., Mann, J., Connor, R., Heithaus, M., Watson-Capps, J., Flaherty, C and Kruetzen, M. 2006b. Decline in relative abundance of bottlenose dolphins (Tursiops sp) exposed to long-term disturbance. Conservation Biology 20 (6): 1791–1798

Butler, R.W. 1980. The Concept of a Tourist Area Cycle of Evolution: Implications for Management of Resources. *Canadian Geographer.* 24(1):5-12.

Constantine, R. 2001. Increased avoidance of swimmers by wild Bottlenose Dolphins (*Tursiops truncatus*) due to long-term exposure to Swim-with-Dolphin Tourism. *Marine Mammal Science* 17 (4), 689-702.

Constantine, R., D. H. Brunton, and T. Dennis. 2004. Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behaviour. *Biological Conservation* 117:299-307.

Corkeron, P. 2004. Whale watching, iconography, and marine conservation. *Conservation Biology*, 18, 847-849.

Duffus, D. A., & Dearden, P. 1990. Non-consumptive wildlife-oriented recreation: A conceptual framework. *Biological Conservation, 53*(3), 213-231.

Findlay, K. 1997. Attitudes and expenditures of whale watchers in Hermanus, South Africa. *South African Journal of Wildlife Research, 27*(2), 57-62.

Gill, J. A., Norris, K. & Sutherland, W. J. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. *Biological Conservation*, 97, 265-268.

Higham, J.E.S. 1998. Tourists and Albatrosses: The dynamics of tourism at the Northern Royal Albatross Colony, Taiaroa Head, New Zealand *Tourism Management* 19(6):521-533.

Higham, J.E.S. and Lusseau D. 2007. Urgent need for empirical research into whaling and whalewatching. Conservation Biology 21: 554-558.

Hoyt, E. 2001. *Whale Watching 2001*. Unpublished report to IFAW and UNEP, London.

Lusseau, D. 2002. *The Effects of Tourism Activities on Bottlenose Dolphins (Tursiops spp.)* in Fiordland. PhD thesis, University of Otago, Dunedin, New Zealand.

Lusseau, D. 2003. The effects of tour boats on the behavior of bottlenose dolphins: Using Markov chains to model anthropogenic impacts. *Conservation Biology* 17(6): 1785-1793.

Lusseau, D. 2004. The hidden cost of tourism: Detecting the long-terms effects of tourism using behaviour information. *Ecology and Society*. 9(1): 2.

Lusseau, D. 2005. Residency pattern of bottlenose dolphins Tursiops spp. in Milford Sound, New Zealand, is related to boat traffic. *Marine Ecology Progress Series.* 295: 265-272.

Lusseau, D. In press. Understanding the impacts of noise on marine mammals. In: Marine Wildlife and Tourism Management: Developing Critical Insights Edited by J.E.S. Higham, and M. Lück. CAB International Publishing, Oxford, UK.

Lusseau D., Slooten E., Higham J.E.S. and Dawson S.M. 2002. *The Effects of Tourism Activities on Bottlenose Dolphins in Fiordland: Towards a Sustainable Solution.* Final report to the Department of Conservation, Wellington, New Zealand.

Lusseau, D. & Higham, J.E.S. 2004. Managing the impacts of dolphin-based tourism through the definition of critical habitats: The case of bottlenose dolphins (*Tursiops* spp.) in Doubtful Sound, New Zealand. *Tourism Management* 25(5): 657-667.

Moberg, G.P and Mench, J. 2000. The Biology of Animal Stress: Basic Principles and Implications for Animal Welfare. CABI Publishing. 337pp.

Rodger, K., Moore, S.A. and Newsome, D. 2007. Wildlife Tours in Australia: Characteristics, the Place of Science and Sustainable Futures. *Journal of Sustainable Tourism* 15(2):160–179.

Samuels, A. and Bejder, L. (2004) Chronic interaction between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. *Journal of Cetacean Research and Management* 6: 69-77.

Shackley, M. (ed). 2001. *Flagship Species: Case studies in wildlife tourism management.* The International Ecotourism Society. Burlington, Vermont..

Williams, R., Trites, A.W. and Bain, D. 2002. Behavioural responses of Killer Whales (*Orcinus orca*) to whale-watching boats: opportunistic observations and experimental approaches. *Journal of Zoology* 256, 255-270.

Figure 1. Duffus and Dearden's (1990) conceptual framework for non-consumptive wildlife tourism.

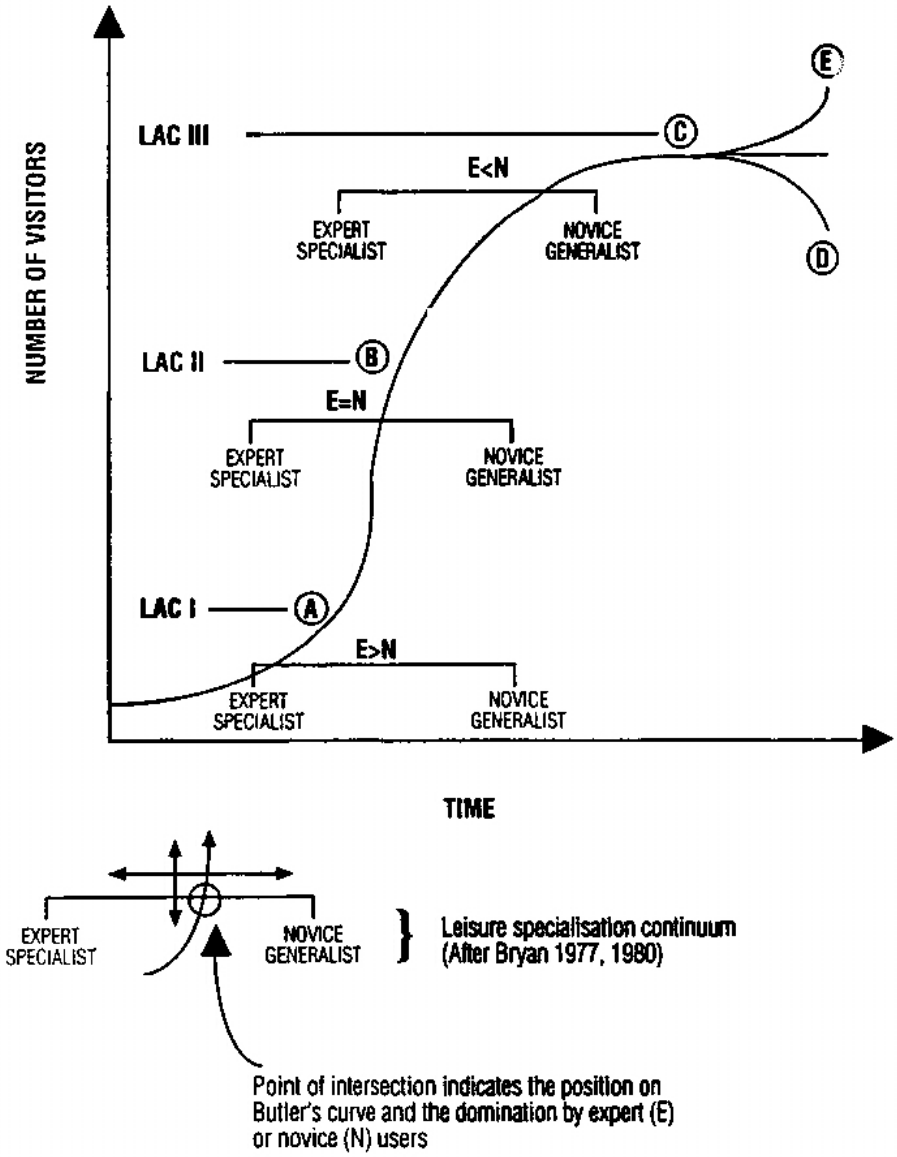
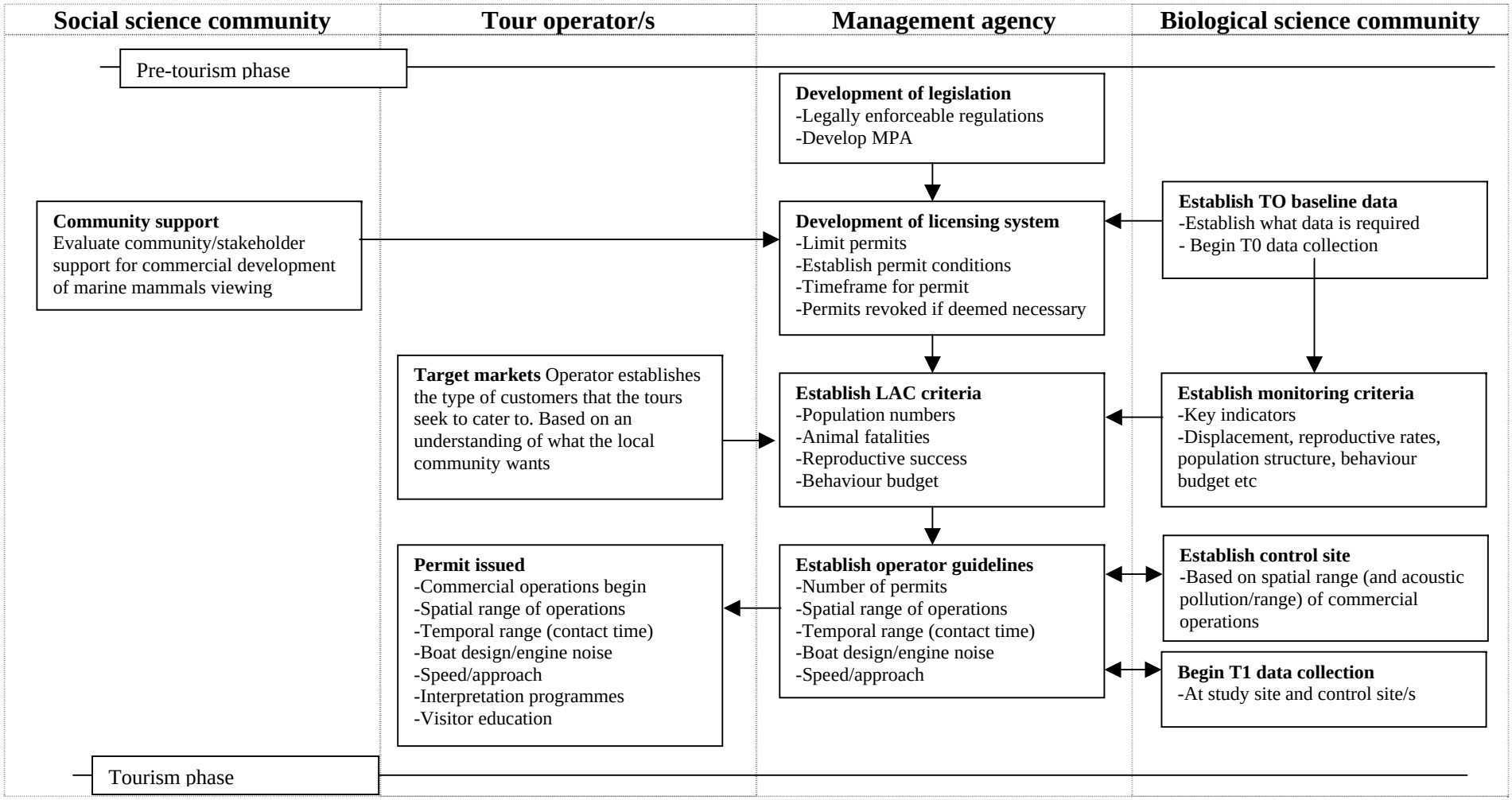
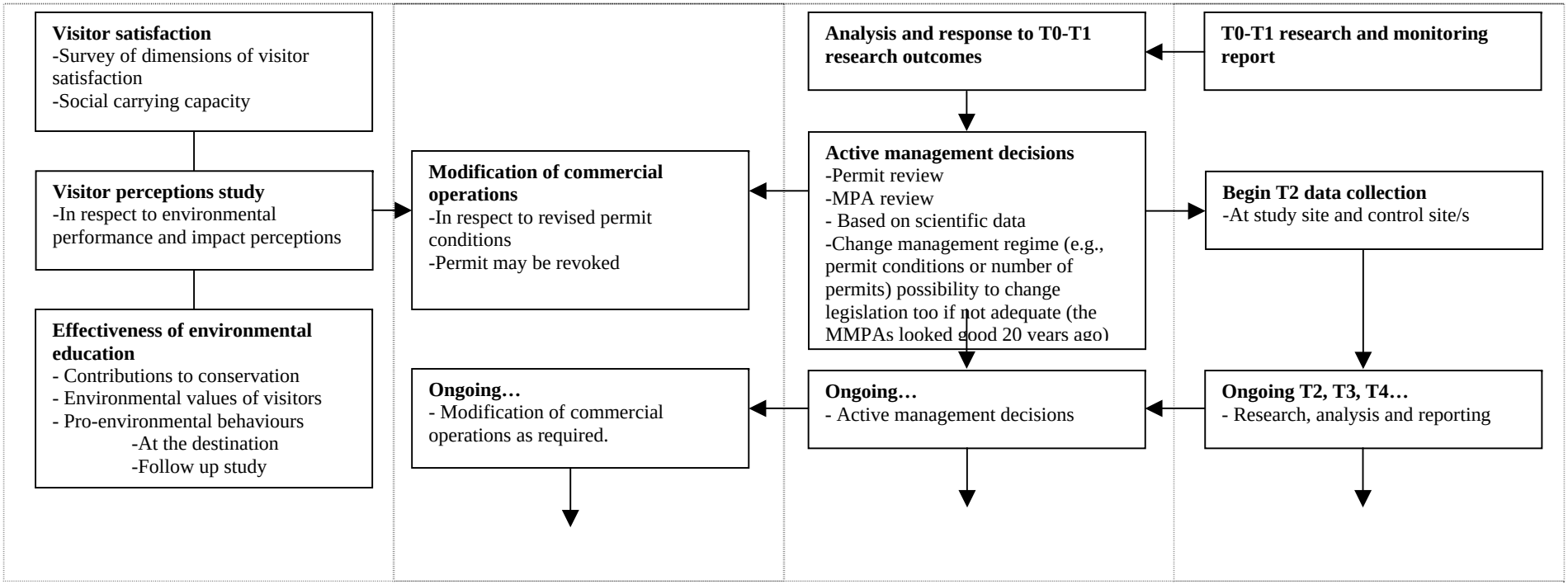


Figure 2. Model for managing the commercial development of wildlife tourism interactions with marine mammals.

Figure 2.
Model for managing the commercial development of wildlife tourism interactions with marine mammals




Visitor satisfaction
-Survey of dimensions of visitor satisfaction
-Social carrying capacity
Visitor perceptions study
-In respect to environmental performance and impact perceptions
Effectiveness of environmental education
- Contributions to conservation
- Environmental values of visitors
- Pro-environmental behaviours
-At the destination
-Follow up study
Modification of commercial operations
-In respect to revised permit conditions
-Permit may be revoked
Ongoing…
- Modification of commercial operations as required.
Analysis and response to T0-T1 research outcomes
Active management decisions
-Permit review
-MPA review
- Based on scientific data
-Change management regime (e.g., permit conditions or number of permits) possibility to change legislation too if not adequate (the MMPAs looked good 20 years ago)
Ongoing…
- Active management decisions
T0-T1 research and monitoring report
Begin T2 data collection
-At study site and control site/s
Ongoing T2, T3, T4…
- Research, analysis and reporting