A FRAMEWORK TO GUIDE THE SUSTAINABILITY OF WILDLIFE TOURISM OPERATIONS

Examples of marine wildlife tourism in Western Australia

Kate Rodger, Amanda Smith, Claire Davis, David Newsome, Philip Patterson
Examples of Marine Wildlife Tourism in Western Australia

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Abstract

Growth in the wildlife tourism industry has been significant in recent years with an increasing focus on tourism centered on free-ranging wildlife. In Australia tourism based in the marine environment, including observing and interacting with coastal and marine wildlife, is increasing in popularity. The future potential for increased growth in marine tourism is dependent upon the abundance and diversity of Australia’s marine wildlife.

Negative impacts of tourism on marine wildlife are difficult to assess as in many cases little is known about the animals or their environment. With the rapid growth in marine tourism the potential for both biophysical and social impacts needs to be recognised. Given the potential impacts and the variable nature of wildlife tourism operations the need arises for a formal auditing and monitoring framework that can identify potential or actual problems and the need for management. This report will examine the opportunities and the barriers in producing a simple, yet reliable framework to assess knowledge available on visitor satisfaction and expectations, identify key areas of product/service improvement, gauge the quality of interpretation programmes, evaluate the effectiveness of impact mitigation strategies and also evaluate the application of key performance indicators for monitoring systems for marine wildlife tourism.

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Sustainable Tourism Cooperative Research Centre (STCRC), established and supported under the Australian Government’s Cooperative Research Centre’s Program, funded this research. The authors would like to thank WA Department of Environment and Conservation (DEC) staff and whale shark tour operators at Coral Bay along with all those who contributed to this report.
SUMMARY

Objectives of Study

The principal aim of this exploratory study is to develop and test the initial stages of a framework to assess the sustainability of marine wildlife tourism operations in Western Australia. In particular, this study uses the available research as a guide to understanding ecological, environmental, operational and social impacts of marine wildlife tourism on both marine wildlife and humans and subsequently develops a wildlife auditing framework. An important objective was to develop a set of indicators for a reliable, yet simple framework in order to sustainably assess and manage marine wildlife tourism interactions. Government managers, tour operators and policy makers can potentially use such a framework to accurately assess and subsequently judge the sustainability of marine wildlife tourism activities. The duration, commitment of resources and timeframe required to generate sufficient scientific information for each species of marine wildlife is often lacking therefore this framework is designed to guide the decision making process in relation to where future research and monitoring is needed to ensure the sustainability of current and future marine wildlife tourism operations.

Methodology

In order to build the framework a literature review was conducted on marine wildlife tourism operations. The wildlife biology, ecology and tourism literature was initially analysed in order to gather material/knowledge on marine wildlife tourism interaction. Included were:

1. target species
   • biology
   • environmental components

2. operational aspects

3. social conditions

4. management issues

From this knowledge base and the researchers own field expertise regarding a knowledge and understanding of wildlife tourism the initial stages of a framework were developed covering the ecological, environmental, operational and social aspects of marine wildlife tourism interactions. Indicators were derived to create a set of generically applicable assessment checklists that would enable future researchers to effectively and accurately examine all target species of marine wildlife across Western Australia. The framework will identify potential areas of concern in relation to marine wildlife tourism interactions as well as highlight where future research and monitoring is needed. To test the capability of the framework it was then applied to the whale shark tourism industry in WA.

Key Findings

- Although there is much research undertaken in marine wildlife tourism interactions, the information is often difficult to source.
- A generic framework to assess the sustainability of marine wildlife tourism operations is difficult to develop.
- The framework knowledge base and indicators needs to be ‘live’ so as new knowledge is reported it can be included in the database and necessary changes to indicators made if needed.
- The framework identifies that for certain marine tourism wildlife interactions there is currently very little scientific knowledge available.
- The application of the framework to the whale shark tourism industry in WA highlighted the lack of knowledge for both ecological/environmental and operational/social areas.
- Visitor compliance to a current code of conduct for marine wildlife interaction was highlighted as an area where research was needed.
- Research undertaken highlighted that there is currently a high rate of compliance with regulations amongst visitors who swim with whale sharks at Coral Bay.
Future Action

This exploratory study recognises the difficulties in establishing a generic framework to assess marine wildlife tourism interactions. Further development of the framework is dependent upon:

- further identification, development and testing of ecological/environmental and operational/social indicators is essential
- inclusion of economic indicators for marine wildlife tourism into the framework is needed
- continued field testing of framework to a range of marine wildlife tourism operations is important
- development of a ‘live’ (easily adapted, up to date and changed as new knowledge becomes available) web based database for each species and online framework application is required
- identification of knowledge gaps for each species that are essential for designing indicators that can be accurately and reliably reflective of marine wildlife tourism is needed.
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Chapter 1

INTRODUCTION

In Australia tourism based in the marine environment, including observing and interacting with coastal and marine wildlife, has been increasing in popularity (Hoyt 2001, Birtles, Valentine & Curnock 2001). Moreover, the future potential for increased growth in marine tourism is dependent upon the abundance and diversity of Australia’s marine wildlife (Birtles, Valentine & Curnock 2001). Thus the advancement of wildlife tourism is reliant on its sustainable base of marine wildlife species of interest to visitors (Newsome Dowling & Moore 2005). With the rapid growth in marine tourism the potential for both biophysical and social impacts needs to be recognised (O’Neill, Barnard & Lee 2004).

Successful wildlife tourism has to meet the needs of tourists and host regions while simultaneously protecting the wildlife, their environment, and social and economic values. To achieve this there is a need to identify the impacts caused by wildlife tourism. Problems associated with wildlife tourism, depending on the species, include stress caused by close contact with wildlife:
- risk of injury to humans
- over feeding
- pollution
- habitat alteration, and;
- alteration of natural behaviour (Newsome, Dowling & Moore 2005).

Wildlife tourism operations can be well established and managed, experience an evolving pattern of visitation, see changes in visitor profiles, and be an emerging attraction. The quality and effectiveness of management may also vary according to location, staffing, funding and in relation to the application of recommendations arising from the results of wildlife tourism research (Smith, Newsome, Lee & Stoeckl 2005,). For example, emerging and yet unmanaged, stingray wildlife tourism as discussed by Lewis and Newsome (2003) and Newsome, Lewis & Moncreiff (2004).

It has been identified that the increase in demand for marine wildlife tourism is happening at a faster rate than management controls can be put in place in order to protect a number of marine species, particularly whales and dolphins (Samuels, Bejder, Constantine & Heinrich, 2003; Higham & Lusseau 2007). Problems associated with wildlife-human interactions include stress caused by close contact with wildlife, risk of injury to humans or wildlife, overfeeding, pollution, habitat alteration and the modification of natural behaviour (Newsome, Dowling & Moore 2005). The negative impacts of marine wildlife tourism are difficult to assess as in many cases the biology, ecology or behavioural responses of the wildlife are not well known or understood (Birtles, Valentine & Curnock 2001, Bejder, Samuels, Whitehead & Gales 2006a). With the rapid growth in marine wildlife tourism, the potential ecological impacts, tourist expectations and attitudes, and satisfaction levels need to be researched and managed to ensure the activity is sustainable (Higginbottom, Rann, Moscardo, Davis & Muloin 2001b; O’Neill, Barnard & Lee 2004; Higham & Lusseau 2007).

Marine Wildlife Tourism in Australia

Wildlife tourism has steadily become one of the biggest industries in the world, with various information, education and interaction experiences provided to millions of people around the world in a huge range of ecosystems (Rodger, Moore & Newsome 2007). This trend has stemmed from a growing division between the the human and natural worlds despite their geographical and biological proximity to each other. This has additionally meant an increasing desire for individuals to re-immerse themselves in natural surroundings and the species that inhabit each unique ecosystem (Rodger, Moore & Newsome 2007). This situation has provided a vital opportunity to benefit local and global economies while maintaining healthy and preserved ecosystems and passing on important conservation messages. This is particularly relevant for Australia, given that one of the country’s most enticing features is the occurrence of rare and unique marine and terrestrial environments, endemic species of flora and fauna, and the relatively easy accessibility to such species (Rodger, Moore &
Examples of Marine Wildlife Tourism in Western Australia

Newsome 2007). Therefore, marine tourism in Australia, including observing and interacting with coastal and marine wildlife, is increasing in popularity (Hoyt 2001; Birtles, Valentine & Curnock 2001). This combination of factors has led to an increase in wildlife tourism attractions and applications for environmental practice licenses in Australia. This is confirmed by the fact that approximately half the official wildlife tourist ventures currently operating in Australia have been established for less than five years (Rodger, Moore & Newsome 2007).

The increased knowledge and understanding of marine life around the world has subsequently enhanced the interest and desire to be closer to many different species of marine animals (Orams 1997). This has been readily observed in several major species in Australia, and also on a more local scale in Western Australia (Rodger, Moore & Newsome 2007). Species of interest to tourism are notably varied, including whale watching, dolphin swims, stingray feeding, sea-lion viewing and swimming interactions with manta rays and whale sharks (Orams 1997; Newsome, Lewis & Moncreiff 2004; Orsini 2004). The variety of these marine wildlife tourism options has now expanded into a significant range of different species and locations across the country (for example see Birtles, Arnold & Dunstan 2002a; Birtles, Valentine, Curnock, Arnold & Dunstan 2002b; Birtles, Arnold, Curnock, Salmon, Mangott, Sobtzick, Valentine, Caillaud & Runney 2008).

The majority of marine wildlife tourism attractions in Australia surround interactions and observations with cetacean species (Orams 1997). Whale-watching, for example, is observed across the country and has now become one of the biggest tourism industries in Australia, consistently ending financial years with a multi-million dollar profits. Whale-watching typically involves commercially booked and managed tours consisting of on-boat observations of natural behaviours (Au & Green 2000). In recent years, unique ‘swim-with’ activities have been conducted with Dwarf Minke Whales (*Balaenoptera acutorostrata*) along the northern regions of the Great Barrier Reef (Valentine, Birtles, Curnock, Arnold & Dunstan 2004). Unlike other whale-human interactions, these tours allow visitors to be in the water with the marine mammals while they swim nearby. As this is a relatively new development in whale tourism, however, there remains an on-going debate with regards to achieving a balance between visitor satisfaction and positive impacts on the whales during such interactions (Valentine et al. 2004).

Interactions with dolphins have also gained significant popularity due to their friendly and curious nature (Smith et al. 2008a). Within Australasia, dolphin watching cruises operate at the following areas:
- selective bays in the islands of New Zealand
- Port Philip Bay (Victoria), Port Adelaide (South Australia), Eden, Merimbula, Forster, Port Macquarie, Jervis Bay, Nelsons Bay, Coffs Harbour (New South Wales), and other smaller operations around the North-East coast in Australia (Orams 1997; Zeppel 2009; Allen et al. 2010).

In Port Phillip Bay the Department of Natural Resources and the Department of Environment has issued five dolphin-swim licences and three dolphin watching licences to separate operations (Scarpaci et al. 2003). In New Zealand, dolphin watch ‘swim with’ tours have proliferated, with over 50 permitted at various locations such as the Bay of Islands, Kaikoura, Whakatane, Whitianga, Picton and Catlins (Orams 1997).

The popularity of shark interactions has also increased significantly world-wide, given the recent developments to provide a greater respect and understanding of species that were feared and heavily avoided historically (Dobson 2008). This has been particularly prevalent within Australia, where the Great White Shark (*Carcharodon carcharias*) utilises several bays and coves throughout South Australia as feeding grounds (York 1998). Both South Australia and South Africa have become major wildlife tourist destinations as a result of tourism ventures that allow under-water cage diving with the large predators (Dobson 2008). This activity has become increasingly popular on both a national and global scale in the last two decades, with tourists of varying ages and ethnic backgrounds actively seeking out such encounters (Dobson 2008). Other notable predator interactions include on-boat observations and feedings of fresh-water and estuarine crocodiles in the Northern Territory (Ryan 1998). This particular species has also seen considerable rise in popularity and interest, with local and international tourist groups engaging in spotting and photographing the large reptiles in their natural habitat (Tourism Western Australia 2008).

Smaller species of marine animals have also become highly popular for the tourism industry, particularly the iconic species such as penguins, turtles and reef fish. Sea-turtles, in particular, have emerged as a potentially successful ‘flagship’ species for conservation of the ecosystems across Ningaloo Reef and the Great Barrier Reef (Wilson & Tisdell 2001). Interactions with turtles currently include on-boat and supervised ‘swim-with‘ activities, as well as beach observations of turtles coming ashore to lay eggs from a regulated distance Mon Repos, Bundaberg. This, in turn has increased awareness and financial support for the six species of marine
turtle found around Australia, all of which are threatened or endangered (Wilson & Tisdell 2001). Interactions with little penguins (*Eudyptula minor*) have also provided significant support for bird and coastal conservation projects, with many thousands of visitors engaging in beach and shoreline observations of penguins’ feeding and breeding activities in the early mornings and evenings (Newsome et al. 2005). Such interactions take place along both coasts of the country, across the east coast of Australia, such as the tours on Phillip Island and at Penguin Island on the West coast (Newsome, Dowling & Moore 2005; Penguin Island Tours 2008). This interest in penguins has also increased interest in bird-watching of oceanic species, such as sea-eagles, albatross and gannets (Albatross and Wildlife Encounters 2008).

Marine Wildlife Tourism in Western Australia

Western Australia is well known as a popular tourist destination, much of which has been due to the range of species for both terrestrial and marine wildlife (Lusseau & Higham, 2004) (Table 1). In 2007, over 250 licenses were issued by the Department of Environment and Conservation (DEC) (2007a) for marine wildlife interactions in WA. DEC ensures that all wildlife based activity licenses issued are in accordance with the Wildlife Conservation Act 1950 (DEC 2007a). The following licenses were issued in Western Australia for 2007:

- 110 whale watching boat tour operator’s licenses. These are mostly for humpback whales with some concentrating on southern right whales along the south coast
- 90 boat based dolphin interaction licenses and three in water licenses. The in water licenses are at Bunbury, Mandurah and Cockburn Sound
- two dugong licenses
- 46 Australian sea lion and New Zealand fur seal interaction licenses
- 14 whale shark interaction licenses within Ningaloo Marine Park (NMP).

(DEC 2007a)

These marine species interactions feature the highly popular ‘swim with’ sessions with whale sharks at Ningaloo Marine Park (Mau & Wilson 2007), and newly developed manta ray ‘swim with’ activities occurring in the same region, particularly in Coral Bay even though there are currently no licenses for ‘swim with’ manta rays (McGregor 2007 pers. comm.). Other popular interactions have also included ‘swim with’ dolphin activities (Hoyt 2001), that have become increasingly popular across Australia, but particularly along the Western Australian coastline in Bunbury and Rockingham (DEC 2007a). In order to successfully develop sustainable management and regulation plans for the various tourism ventures into the long-term future, there needs to be a thorough overview of current wildlife tourism activities across Australia comparing these in detail with the current practices relevant to Western Australia. The eight major species involved marine wildlife tourism charters (see Table 1) are the focus of the present study.

**Table 1: Major sources of marine wildlife tourism in Western Australia**

<table>
<thead>
<tr>
<th>Marine Wildlife</th>
<th>Location</th>
<th>Viewing Platform</th>
<th>Activity</th>
<th>Tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whale shark</td>
<td>Exmouth, Coral Bay</td>
<td>land/boat-based/in water/aerial</td>
<td>observation/swim-with</td>
<td>commercial</td>
</tr>
<tr>
<td>Manta ray</td>
<td>Exmouth, Coral Bay, Shark Bay</td>
<td>shore/boat-based/in water</td>
<td>observation/swim-with</td>
<td>recreational/commercial</td>
</tr>
<tr>
<td>Bottlenose dolphin</td>
<td>Exmouth, Monkey Mia, Rockingham Bunbury</td>
<td>boat/shore/in water</td>
<td>observation/swim-with/feeding</td>
<td>commercial/recreational</td>
</tr>
<tr>
<td>Australian sea lion</td>
<td>Carnac Island, Wedge Island, Perth</td>
<td>kayak/boat-based/shore/in water</td>
<td>observation</td>
<td>recreational/commercial</td>
</tr>
<tr>
<td>Stingray</td>
<td>Hamelin Bay</td>
<td>shore based/in water</td>
<td>observation/feeding</td>
<td>recreational/commercial</td>
</tr>
<tr>
<td>Humpback whale</td>
<td>Exmouth, Perth, Fremantle, Augusta</td>
<td>aerial/boat-based/shore based</td>
<td>Observation</td>
<td>commercial</td>
</tr>
<tr>
<td>Dugongs</td>
<td>Shark Bay, Exmouth</td>
<td>boat-based</td>
<td>observation</td>
<td>commercial</td>
</tr>
<tr>
<td>Turtles</td>
<td>Exmouth/Dirk Hartog Island/Coral Bay</td>
<td>shore/boat-based/in water</td>
<td>observation</td>
<td>recreational/commercial</td>
</tr>
</tbody>
</table>
Examples of Marine Wildlife Tourism in Western Australia

Project Objectives

In order to understand, simplify and successfully develop sustainable management and regulation of marine wildlife tourism, there needs to be the development of a set of generic, applicable assessments or checklists on the ecological, operational and social practices of such marine wildlife tourism activities across all species. A key requirement for sustainably managing marine wildlife tourism interactions is the ready availability of user-friendly guidance to the selection and development of suitable monitoring indicators and protocols for the species/circumstances in question, and of suitable relatively inexpensive monitoring protocols. However, there is currently no reasonably comprehensive practical reference available on techniques for sampling or monitoring impacts of visitor use—or indeed for monitoring in general, on Australian wildlife. The available information is patchy, mostly restricted to the scientific/academic literature, and often not designed for user-friendly application to specified applied situations.

A wide range of issues from ecological/environmental and operational/social aspects need to be considered in developing suitable methods of wildlife monitoring for a given situation. For example issues such as:

- type of visitor interaction with wildlife (e.g. feeding, observation, incidental in the course of other tourism-related activities)
- spatial distribution and intensity of the activity
- activity/component of the wildlife population most likely to be affected (e.g. breeding colony, foraging animals, animals during their daytime resting phase)
- resources and skills available for monitoring, and;
- visitor demographics.

Therefore, the principal aim of this exploratory study is to develop and test the preliminary stages of a framework to assess the sustainability of marine wildlife tourism operations in Western Australia. To develop a framework suitable for assessing the sustainability of marine wildlife tourism operations the following objectives were pursued:

- design and develop a set of indicators to produce a reliable yet simple framework
- include ecological/environmental and operational/social components
- apply the framework to a marine wildlife operation (ie whale shark tourism in Coral Bay) and conduct further research if needed
- review the sustainability of the framework.

Government managers, tour operators and policy makers can potentially use such a framework to accurately assess and subsequently judge the sustainability of marine wildlife tourism activities. The framework is designed to guide the decision making process in relation to concepts of ‘best practice’ and the sustainability of current and future marine wildlife tourism operations.
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Chapter 2

DEVELOPING THE FRAMEWORK

To develop the framework a thorough literature review on marine wildlife tourism operations was undertaken. In particular the review focussed on the main marine wildlife tourism operations in WA including whale sharks, manta rays, bottlenose dolphins, humpback whales, sea lions, dugongs and turtles (see Appendices A—H). The literature review sought all available knowledge on the ecological/environmental and operational/social aspects of these marine wildlife tourism interactions. The review discovered that much research on marine wildlife tourism operations has been undertaken in recent years however it is often difficult to locate and collate due to it being published in a variety of areas. Knowledge on marine wildlife tourism operations were found in a variety of journals including those which focussed on: environmental biology; ecological science; marine mammal science; animal behaviour; wildlife research; fisheries; conservation biology; environmental management; tourism; and zoology.

The literature review was used in conjunction with the authors’ own knowledge and field experience of marine wildlife tourism to design and develop the initial framework. Indicators were developed to assess and monitor the trends associated with those that are suggestive of negative and potentially detrimental consequences to both the visitors, the tourism industry, and the specific species of animals involved. These indicators consist of assessment criteria on major sections of the tour operation, predominantly on ecological, environmental, operational, management, regulations and legislation as well as social aspects of best practice.

Ecological and Environmental

The nature of the impacts of human disturbance on wild marine animals is complex. The potential impacts go beyond any immediately observable short-term response. For example, ecological/environmental indicators of potential impacts to marine species need to consider the following:

- transmission of diseases
- human safety
- cetacean disturbance and safety
- interference with foraging, mating, socialising, calving, rearing
- group dispersion/cohesion—cetaceans are thought to bunch together in situations of surprise, threat or danger and such behaviour can therefore be used as an indicator of disturbance
- behavioural state/activity budgets: disturbance can lead to changes in behaviour, i.e. a decrease in feeding or resting time, which can lead to a decrease in the activity budget of the animal lowering its chances of survival or reproductive success
- behavioural events: the presence or absence of behavioural events, i.e. signs of aggression such as leaps and tail slaps with cetaceans
- ranging patterns and habitat use: animals may not to go to preferred breeding, resting or feeding areas if disturbance is present resulting in disturbance to social groups and behaviours’ with resultant decreases in positive activity budget
- data on frequency and duration of interaction
- sex/age/individual identification
- a determination of the group’s demographics including population stability and recruitment over time.
- the ranging patterns and habitat utilisation: this can be determined by documenting reduced usage of a favourite area, pre disturbance compared to post disturbance


Operational and Management

Tourism operators have to be knowledgeable in order to conduct a good wildlife tourism business in terms of customer satisfaction and environmental management (Newsome Dowling & Moore, 2005). Tourist operators...
should receive relevant training and education to ensure that they understand the principles of sustainable wildlife tourism and can manage their operations accordingly (Higginbottom, Rann, Moscardo, Davis, & Muloin, 2001b, Scarpaci, Dayanthi & Corkeron, 2003, Allen et al., in press). The operator can then use this knowledge to supply accurate and informative interpretive material or guides to advise the visitor as to what to expect, what they are likely to see and how they should behave around wildlife (Newsome, Dowling & Moore, 2005).

Tensions between operators and managers can develop when operators want greater access to more wildlife and the managers want stronger conservation measures in place (Moscardo, Woods & Greenwood, 2001). Operators often complain that management decisions are made on philosophical or social objections and not on sound scientific evidence (Moscardo, Woods & Greenwood, 2001). However, often the scientific knowledge is not available. This lack of understanding and communication between the two parties needs to be improved (Moscardo, Woods & Greenwood, 2001).

An understanding is needed on the impact of activities on wildlife, visitors’ awareness of their impacts and their perceptions of management actions (Moscardo, Woods & Greenwood, 2001). Tour operators can provide information to managers on how visitors perceive management actions and if they remain satisfied (O’Neil, Barnard & Lee 2004). This information would help managers to implement actions that are satisfactory to visitors and protect the wildlife (O’Neil, Barnard & Lee, 2004). There is little evidence to support the common perception that restrictions and low levels of access reduce visitor satisfaction (Moscardo, Woods & Greenwood, 2001).

Marketing approaches used to encourage visitors, such as ‘up close’ encounters or ‘come face to face with’ may be inappropriate for some species (Orams 2000). If an operator defines success as touching an animal this can persuade the visitors that they will be only be satisfied if they touch one (Sorice, Schafer & Ditton, 2005). There are other factors that add to the visitors’ enjoyment, that the operator could control, such as design and positioning of the ship for whale watching, interpretation and the number of passengers and the duration of trip (Orams 2000) or focus on other marine wildlife species (Zeppel & Muloin 2008).

Regulations and Legislation

All marine wildlife interaction activities in Western Australia have specified licence conditions and rules associated with them provided for by legislation (Newsome, Dowling & Moore, 2005). In Western Australia protection to marine wildlife is afforded under the Western Australian Wildlife Conservation Act 1950. While the Conservation And Land Management (CALM) Act 1984 of Western Australia addresses the issues of licensing and conditions for commercial whale shark operators (Davis & Banks 1997). Licence conditions may specify rules for operators such as contact time for boats, number of passengers, minimum approach distances and requests to respect the wildlife (Davies & Banks 1997). Controlling the number of licences available is a method of limiting the number of marine wildlife-human interactions that can take place. Licences set the rules by which operators must abide but it does not control the quality of the overall experience (Hughes Carlsen, Bamford & Howson, 2004). Interpretation and interaction values may vary between operators giving wildlife experiences of differing quality.

In the past regulations and guidelines for tourism around the world have often been developed from anecdotal knowledge often with little or no scientific information. Management policies invariably have not accounted for different species, age, sex, habitat, behaviour or group composition of targeted animals (Bejder & Samuels 2003). General guidelines for minimal impact cetacean watching can be summarised as:

- minimising boat speed and avoiding sudden changes in direction
- specified approach distances
- use a minimum disturbance approach direction and angle of approach
- reduce noise levels (from engines and propellers)
- avoid the pursuit, encirclement or separation of cetaceans
- let cetacean control the interaction, its duration and nature of experience
- consideration of cumulative effects of time spent with cetacean and number of boat trips
- special care should be taken with groups including females and calves.

(WDCS 2007)

These elements are comparable to those for ‘swim-with’ dolphin licence conditions in Western Australia as defined by DEC. While the proposed DEC code of conduct for manta ray interaction in Ningaloo Marine Park
also adheres to these same principles it adds conditions for restricting interactions close to critical habitats and mantas displaying mating/courting behaviours (Mau pers. comm. 2007). The code of conduct for whale shark interaction in Ningaloo Marine Park is based on similar principles to the guidelines for cetacean viewing but it incorporates other aspects that are relevant to the location and ‘swim with’ activity. For example, it specifically prohibits the use of flash photography, motorised or non-motorised towing equipment and SCUBA equipment.

Managers can place requirements on permits and licences that request tour operators to collect tour information. This can be information on the use of the resource, temporal variations in demand and the differences between the types and sizes of operators (Moscardo & Ormsby 2004, Mau & Wilson 2007). However, this does not account for recreational users (incidental and/or unsupervised contact with wildlife as part of general recreational activity) and if the area has recreational users this may be a significant gap in the data. Managers need to understand the impact from recreational users as well as that of the commercial user. In some cases the recreational user may not be aware of, or bound under, regulations and may act inappropriately as a result, increasing the pressure on tourism operators and wildlife (Sorice, Schafer & Ditton, 2005).

Social Conditions

Understanding the social aspects of marine wildlife tourism is important so that managers can provide the appropriate type and amount of facilities for the activity (Higginbottom, Rann, Moscardo, Davis & Muloin, 2001a). To achieve this, managers of a marine tourism operation would require knowledge of the actual demand for the activity, the characteristics of the visitors and their level of specialisation. Management of visitors’ behaviour during wildlife interactions can be simpler if the motivation, satisfaction and nature of demand is understood (Duffus & Dearden 1990).

In recent years the Sustainable Tourism Cooperative Research Centre (STCRC) has undertaken much research in wildlife tourism in Australia (Higginbottom et al. 2001a, Moscado & Saltzer 2004). To develop a sustainable wildlife tourism activity past research has identified knowledge is needed in the following areas:

- determination of the size and nature of demand for various forms of wildlife tourism,
- determination of visitor expectations, motivations, and needs,
- determine of reactions in relation to existing wildlife tourism experiences, especially in relation to satisfaction, and influencing factors,
- determination of the variability between market segments in the above,
- assessment of visitor responses to different approaches of visitor management designed to minimise negative effects on wildlife and influence visitor behaviour,

One of the critical research gaps in the wildlife tourism field is in the lack of understanding of the demand for wildlife tourism activities, including the nature of the demand and how this varies between market segments (Higginbottom et al. 2001a). It is important to understand the demand of an attraction so that the correct number of facilities and products can be developed and improved (Moscardo, Woods & Greenwood 2001). Underestimating the demand could result in too many operators increasing the competition and pressure on the wildlife and managers not able to provide effective management actions. Overestimates could result in an over supply of facilities using financial or staffing resources that the operators or area managers may have been able to put to better use elsewhere (Higginbottom et al. 2001a).
Chapter 3

THE FRAMEWORK

Managing a sustainable marine tourism activity is complex, particularly within the current context of the various marine tourism activities in Western Australia. There are numerous stakeholders involved, managers, researchers, operators and visitors that will make different evaluations of the marine wildlife activity. Each stakeholder will have different perceptions and knowledge regarding the marine tourism industry (Higham, Bejder & Lusseau, 2009). For commercial marine wildlife tourism to maintain a long-term achievement of financial success, popularity and to be a significant factor in encouraging environmental conservation, there needs to be consistent and accurate assessment of both ecological and social issues within each tour operation (Newsome, Dowling & Moore 2005). Both ecological/environmental and operational/social indicator audits and investigations have not yet been extensively researched within the Western Australian context, but do show potential for direct application to different marine wildlife tour operations, which could eventually lead to the development of a generic set of checklists and assessment models that can be applied accurately, reliably and validly across all such circumstances in the state. This idea is reinforced by Higham, Bejder & Lusseau (2009) who argued that the need for integrated assessments of stakeholder involvement and impacts on wildlife, particularly those highly popular species such as whales and dolphins, is now essential given the scope and size of the marine wildlife tourism industry across the globe.

The current literature has indicated that the strength of knowledge, concerning both specific species background and major operational and social stakeholders associated with marine wildlife tourism, should provide the opportunity to develop a generic, applicable assessment model for all current species. Such a development would have numerous benefits to the marine wildlife tourism field. For example, such an assessment would subsequently result in a greater understanding of wildlife tourism practice and a more concentrated effort to improve current levels of operation. In addition, it is likely to create a known standard of ‘best practice’ for tourism operators and governing bodies who monitor them, making it easier to observe areas of concern with specific species activities. Furthermore, these assessments may also highlight the extent of knowledge gaps in marine species that may stimulate further research into those aspects of a certain species’ physiology, behaviour or relationship to humans that is still poorly understood, which has been observed in a number of Western Australian marine species (Simmonds 2004; Mau 2006; Higham & Lusseau 2007).

However, as the current literature review has demonstrated (see Appendices), there is a great complexity of both ecological, operational and social issues to be considered when attempting to assess ‘best practice’ in any given marine wildlife tour (Newsome, Dowling & Moore 2005; Semenuik 2008). Therefore, there is a need to divide the model into two separate checklists or assessments; one for operational and social aspects of the tours and one set of assessments for ecological impacts and environmental responsibility. In this manner, the rationale and details of both sets of assessments can be devised and reviewed with a better chance of remaining reliable, accurate and generically applicable to all marine wildlife cases.

The Ecological and Environmental Framework

Attempting to construct a generic set of assessments for ecological and environmental responsibility for marine wildlife tourism is a far more challenging proposition, given its greater complexity and variation across the different species (Newsome, Dowling & Moore 2005; Semenuik 2008).

Issues such as:
- physical impacts
- behavioural impacts
- species-species patterns
- reactions to human behaviour, and;
- specific physiological changes due to human activity

are all critical for consideration and vary greatly on the animal of interest (Semenuik 2008). Despite these challenges, a generic framework was developed with the assistance of preliminary species-specific indicator research that allows for a generic comparison across each individual species. A prototype
A FRAMEWORK TO GUIDE THE SUSTAINABILITY OF WILDLIFE TOURISM OPERATIONS

ecological/environmental responsibility assessment for marine wildlife tourism is provided, based on the reviewed ecological knowledge and environmental issues (Table 2).

The selection of the proposed criteria in the framework are based on both field research and theoretical models of marine wildlife tourism which have been illustrated as being critical to managing and monitoring physical and behavioural aspects of marine species. This framework is for the focal species where the tourism wildlife interaction occurs.

Table 2: Ecological and environmental indicators for framework

| 1. Species | Whale shark | Pinnipeds | Turtle spp. |
|            | Manta ray   | Stingray spp. | Dugong |
|            | Whale spp.  | Dolphin spp. | Other |

<table>
<thead>
<tr>
<th>2. Threatened status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critically endangered</td>
</tr>
<tr>
<td>Vulnerable</td>
</tr>
<tr>
<td>Endangered</td>
</tr>
<tr>
<td>Conservation dependent</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Group dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lone/solitary</td>
</tr>
<tr>
<td>Males</td>
</tr>
<tr>
<td>Group/cluster</td>
</tr>
<tr>
<td>Females</td>
</tr>
<tr>
<td>Females with calves</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Age of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juveniles</td>
</tr>
<tr>
<td>Mature</td>
</tr>
<tr>
<td>Adolescent</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Known behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
</tr>
<tr>
<td>Migratory</td>
</tr>
<tr>
<td>Territorial</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
</tr>
<tr>
<td>Decreasing</td>
</tr>
<tr>
<td>Increasing</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

Knowledge of species reproduction

<table>
<thead>
<tr>
<th>7. Knowledge of number of animals occurring in interaction zone/area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Knowledge of feeding behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. Habitat where tourism interaction takes place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. Have any potentially negative impacts from tourism been identified?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes if so please describe</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. Known behavioural response to tourism Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidance</td>
</tr>
<tr>
<td>Temporary disturbance</td>
</tr>
<tr>
<td>Attraction</td>
</tr>
<tr>
<td>Permanent displacement</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Habitation</td>
</tr>
<tr>
<td>Aggressive response</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>Passive response</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

| 12. Are there other anthropogenic activities other than the tourism activity placing pressure on species? |
| (for example pollutants in water, sewerage, dredging...) |
| Yes if so please describe? |
| No                                                                       |

<table>
<thead>
<tr>
<th>13. Is there consistent long-term research and/monitoring taking place?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>
Examples of Marine Wildlife Tourism in Western Australia

Unknown
A FRAMEWORK TO GUIDE THE SUSTAINABILITY OF WILDLIFE TOURISM OPERATIONS

The framework refers to the extent of knowledge from tour operators and managers on the local wildlife population and typical habitat locations of the species involved in the interactions. This knowledge allows tour operators and managers to identify the overall health and welfare of the local community of species, what areas can be safely used for interactions and what areas need to be avoided in order to reduce physical or behavioural impairment (Orams 2002). This has been particularly evident for bottlenose dolphins in Western Australia, New South Wales and New Zealand, in which populations of dolphins have been extensively monitored and examined, providing information on the number of dolphins in the area, their breeding success, diet, feeding grounds and resting areas which need to be safely avoided (Orams 2002; Constantine, Brunton, & Dennis. 2004; Dolphin Discover Centre [DDC] 2005; Zeppel 2009).

Additional questions in the framework enables further examination of the measurable levels of both physical health and natural behaviour patterns of the animals and their surrounding ecosystem which may be impaired by tour interactions. Such assessments have already been used by a series of studies into bottlenose dolphin studies, which have often been able to identify distinct changes in feeding activities, social interactions, and resting periods for dolphins when continually exposed to intense human interactions, particularly from motor boats (Janik & Thompson 1996; Nowacek, Wells, & Solow. 2001; Lusseau 2008). In addition, the use of such assessment criteria in dolphin tourism have shown how shallow coves and weed banks can be significantly damaged by consistent, excessive boat activities in dolphin resting areas, suggesting the need for changes in the activity procedures (Nowack, Wells & Solow, 2001).

Knowledge about the potential impacts associated with the tour activities is one of the most important aspects of ecological assessment in wildlife tourism, as it highlights what risks to the animals have been identified, and subsequently how the operations can be developed to reduce these risks to a minimum (Newsome, Dowling & Moore 2005). In bottlenose dolphins, for example, an extensive range of potential risks have been identified and applied to tourism practices, such as the threat of direct physical injury from boats, indirect stress or disruption of natural behaviours, noise pollution, and excess proximity to the animals themselves (Bejder, Dawson & Harraway 1999; Nowacek, Wells & Solow 2001; Lusseau 2008). This knowledge base may also include specific knowledge of the local population of animals, such as specific resting or breeding areas and areas used by other recreational activities (Bejder & Samuel, 2003).

The Operational and Social Framework

Research into marine wildlife tourism has identified a series of critical operational and social issues that are common to the vast majority of species cases (Newsome, Dowling & Moore 2005; Higham & Hendry 2008). Examples of such issues that are applicable to multiple species tours have included number of interactions, types of interaction, regulations in place, visitor needs, education, interpretation, visitor control, health and safety considerations and satisfaction levels (Newsome Dowling & Moore 2005; Higham & Hendry 2008). A prototype example of a generic checklist is shown in Table 3, based on such social and managerial issues:
### Examples of Marine Wildlife Tourism in Western Australia

#### Table 3: Operational and social indicators

<table>
<thead>
<tr>
<th>1. Type of activity</th>
<th>2. Reliability of wildlife viewing</th>
<th>3. Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Swim with</td>
<td>- Consistent viewing</td>
<td>- Easily viewed from shore</td>
</tr>
<tr>
<td>- View from Plane</td>
<td>- Reliable of wildlife viewing</td>
<td>- Off shore</td>
</tr>
<tr>
<td>- Fixed platform viewing</td>
<td>- Yes</td>
<td>- Short distance (≥ 1 hour travel)</td>
</tr>
<tr>
<td>- Kayak</td>
<td>- Daily</td>
<td>- Long distance (&lt;1 hour travel)</td>
</tr>
<tr>
<td>- Dive</td>
<td>- Yes</td>
<td>- Other</td>
</tr>
<tr>
<td>- Feeding</td>
<td>- Weekly</td>
<td></td>
</tr>
<tr>
<td>- Fixed platform viewing</td>
<td>- Infrequently</td>
<td></td>
</tr>
<tr>
<td>- Helicopter viewing</td>
<td>- Other</td>
<td></td>
</tr>
<tr>
<td>- Kayak</td>
<td>- Radio communication</td>
<td></td>
</tr>
<tr>
<td>- Shore based</td>
<td>- Feeding</td>
<td></td>
</tr>
<tr>
<td>- Non motorised boat</td>
<td>- Other</td>
<td></td>
</tr>
<tr>
<td>- Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Licence required by operator</th>
<th>5. Frequency of interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Yes</td>
<td>- Year around</td>
</tr>
<tr>
<td>- No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Number of tours for focus species</th>
<th>7. Interaction with focus species</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Day</td>
<td>- Average number of visitors per interaction</td>
</tr>
<tr>
<td>- Week</td>
<td>- Average number of interactions with focus species per tour</td>
</tr>
<tr>
<td>- Year</td>
<td>- Average length of time spent with focus species per interaction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Interactions between operators overlap</th>
<th>9. Private recreation component interacts with focus species</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Yes</td>
<td>- Yes</td>
</tr>
<tr>
<td>- No</td>
<td>- Unknown</td>
</tr>
<tr>
<td>- Unsure</td>
<td>- No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. Guidelines, regulations/policies for focus species interaction</th>
<th>11. Knowledge on rate of compliance for tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Yes</td>
<td>- Yes</td>
</tr>
<tr>
<td>- Codes of conduct</td>
<td>- High rates of compliance recorded</td>
</tr>
<tr>
<td>- Memorandum of understanding</td>
<td>- Medium rates of compliance recorded</td>
</tr>
<tr>
<td>- Legislation</td>
<td>- Low rates of compliance recorded</td>
</tr>
<tr>
<td>- Policy</td>
<td>- Unknown</td>
</tr>
<tr>
<td>- Other</td>
<td>- No</td>
</tr>
<tr>
<td></td>
<td>- Unsure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. Knowledge on rate of compliance for operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Yes</td>
</tr>
<tr>
<td>- High rates of compliance recorded</td>
</tr>
<tr>
<td>- Medium rates of compliance recorded</td>
</tr>
<tr>
<td>- Low rates of compliance recorded</td>
</tr>
<tr>
<td>- No</td>
</tr>
<tr>
<td>- Unsure</td>
</tr>
</tbody>
</table>
The operational and social framework includes attributes on management issues including types of
teractions, accessibility to the wildlife, rates of compliance by visitors and operators, and regulations and
guidelines. The type of interaction and the extent to which visitors comply is central to the concept of
responsible operation and practice, as it directly identifies not only the well-being of the tour visitors and wildlife
in question, but also the extent to which the monitoring, briefing and management of the wildlife experience is
being employed (Newsome, Dowling & Moore 2005; Quiros 2007). Moreover, having a set of codes, regulations
and guidelines of this nature has been identified as being critical to maintaining a consistent, reliable practice
with both visitors and in relation to animal welfare that can be easily referred to and managed across a variety of
foreseeable actions or consequences (Davis & Banks 1997; Newsome, Dowling & Moore 2005).

Visitor demographics are also included in the framework. As Higginbottom et al. (2001a) highlights, a
thorough knowledge of visitor characteristics and features is one of the core actions associated with successful,
responsible practice of a charter and understanding it’s dynamics. In addition, such texts have highlighted the
importance of having a wide diversity of visitors engaged in the interactions, which provides a wider, global
influence concerning the protection and respect of marine wildlife and respective ecosystems (Moscardo &
Ormsby 2004).

Interpretation and visitor safety, health and welfare are included as well as the need to monitor the tourism
interactions. Such actions and protocols are essential if operators are to maintain a successful, responsible and
enjoyable experience, which is applicable to all marine wildlife tours, regardless of species or the type of
interaction (Higginbottom et al. 2001a).
TESTING THE FRAMEWORK

To test the effectiveness of the framework it was decided to complete the checklist with current knowledge available from the whale shark tourism industry in the Ningaloo Marine Park WA. The popularity of interactive swims, with whale sharks in particular, has resulted in huge demand and attention from virtually all ages and ethnicity within the tourist population (Davis & Banks 1997). This has subsequently resulted in new challenges for tourist and conservation bodies, to provide research, education and understanding of the sharks and the ecosystem they inhabit, while ensuring that the animals themselves are not excessively disturbed or affected to the point that natural behaviours are no longer observed (Davis & Banks 1997). The whale shark tourism industry in Ningaloo was chosen for this pilot study as the financial success, popularity and high environmental responsibility from both the social and environmental perspectives of the Ningaloo whale shark tours has recently led the industry to be considered as one of the best examples of ecotourism practice in the country (Mau 2006).

Applying the Framework to the Whale Shark Tourism in Coral Bay, Western Australia

Coral Bay is a small town in the north-west of Australia, approximately 120 kilometres south of Exmouth and one of the major tourist towns of the Ningaloo Marine Park and its array of coral reefs. Coral Bay has now become one of the most popular locations in Western Australia for boating and marine activities, with up to 60 recreational vessels spotted within the main bay peak seasons from March to October. According to recent statistics, approximately 200,000 tourists visit the Ningaloo region annually (CALM 2005). The rise in the popularity of Coral Bay and the nearby towns of Exmouth has been largely due to the local tourist businesses offering a range of wildlife interactions (CALM 2000).

The current level of whale shark ‘swim with’ activities has brought about the need for caution and consideration of the impact of tourism on the shark’s behaviour and physical health (Quiros 2007). Previous studies have indicated that a number of potential impacts may arise if such tourist ventures are not properly managed, including disruption of feeding patterns or inhibited breeding condition (Mau, 2008). To combat this in the North-west coast of Australia, measures have been taken to minimise these negative impacts. These include the monitoring and regulation of official charter licenses, ensuring the spotter planes do not come close to the surface of the water when scouting for sharks, and that the visitors do not come within three metres of the shark when engaged in the ‘swim with’ activities (Mau 2008) (Table 4).
Table 4: Outline of regulations for interaction with whale sharks across Ningaloo Marine Park

<table>
<thead>
<tr>
<th>Type of interaction</th>
<th>Regulation/rules for interacting with whale shark</th>
</tr>
</thead>
<tbody>
<tr>
<td>tourists swimming with sharks</td>
<td>maximum ratio of swimmers to sharks at any one time of 10:1 (e.g. 10 swimmers in the water for every one shark)</td>
</tr>
<tr>
<td></td>
<td>swimmers to be at a maximum of 4 metres from sharks’ tail</td>
</tr>
<tr>
<td></td>
<td>swimmers to be maximum of 3 metres from the sharks’ body</td>
</tr>
<tr>
<td></td>
<td>use of ‘duck-diving’ technique or use of SCUBA gear not permitted</td>
</tr>
<tr>
<td></td>
<td>motorised floatation devices not permitted</td>
</tr>
<tr>
<td></td>
<td>no touching permitted</td>
</tr>
<tr>
<td></td>
<td>inflatable boats only permitted when swimmers are struggling to get back on board</td>
</tr>
<tr>
<td>boat observations of sharks</td>
<td>boats to be no closer than 30 metres from the sharks</td>
</tr>
<tr>
<td></td>
<td>speed of boat when near sharks, must not exceed 8 knots</td>
</tr>
<tr>
<td></td>
<td>no other vessel may be come within 250 metres of contact zone of the boat currently engaged in whale shark interactions</td>
</tr>
<tr>
<td></td>
<td>vessels may spend a maximum of 60 minutes within the 250 metre contact zone of the shark</td>
</tr>
<tr>
<td></td>
<td>all licence holders and tour operators must report any serious incidents or violation of conduct codes by un-official or un-licensed boat owners to DEC</td>
</tr>
</tbody>
</table>

(Source: Mau 2008)

The knowledge collated (Appendix A) was used to complete both the ecological/environmental and operation/social aspects of the framework for the whale shark tourism industry in Coral Bay, WA (Table 5 & 6).

Table 5: Ecological and environmental indicators for framework applied to whale shark tourism

| 1. Species |  |
|---|---|---|
| ✓ Whale shark | ☐ Sea lions | ☐ Turtles |
| ☐ Manta ray | ☐ Stingray | ☐ Dugongs |
| ☐ Humpback whales | ☐ Dolphins | ☐ Other |

<table>
<thead>
<tr>
<th>2. Threatened status</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Critically endangered</td>
<td>✓ Vulnerable</td>
</tr>
<tr>
<td>☐ Endangered</td>
<td>☐ Conservation dependent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Group dynamics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Lone/solitary</td>
<td>✓ Males</td>
</tr>
<tr>
<td>☐ Group/cluster</td>
<td>☐ Females</td>
</tr>
<tr>
<td>☐ Mothers with calves</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Age of species</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Juveniles</td>
<td>☐ Mature</td>
</tr>
<tr>
<td>✓ Adolescent</td>
<td>☐ Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Known behaviour</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Social</td>
<td>✓ Migratory</td>
</tr>
<tr>
<td>☐ Territorial</td>
<td>☐ Unknown</td>
</tr>
</tbody>
</table>
Examples of Marine Wildlife Tourism in Western Australia

Table 6: Operational and Social Indicators for whale shark tourism

<table>
<thead>
<tr>
<th>1. Type of Activity</th>
<th>2. Reliability of wildlife viewing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swim with Plane</td>
<td>Yes</td>
</tr>
<tr>
<td>Dive</td>
<td>Daily</td>
</tr>
<tr>
<td>Helicopter</td>
<td>Spotter plane</td>
</tr>
<tr>
<td>Platform viewing</td>
<td>Yes</td>
</tr>
<tr>
<td>Motorised boat</td>
<td>Radio communication</td>
</tr>
<tr>
<td>Non motorised boat</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>Weekly</td>
</tr>
<tr>
<td>No</td>
<td>Infrequently</td>
</tr>
<tr>
<td>Unknown</td>
<td>Other</td>
</tr>
</tbody>
</table>

The application of the framework highlighted that there are still gaps in ecological and environmental knowledge of whale sharks. Of most concern would be the lack of knowledge on population numbers of whale sharks, their reproduction and reported negative impacts from tourism. The findings from the framework are supported by the literature that highlight existing knowledge gaps as breeding behaviour, female diet and habitat requirements during gestation periods, social interaction and extent of human-based impact on natural behaviours (Mau 2008; Martin 2007a). However, as there is currently scientific research into whale sharks taking place along with long term monitoring it would be recommended that the precautionary principle be applied to potentially limit tourist interactions.
### 3. Accessibility
- **☑ Easy viewed from shore**
- **☑ Off shore**
- **☑ Short distance (> 1 hour travel)**
- **☑ Long distance (<1 hour travel)**
- **☑ Other**

### 4. Licence required by operator
- **☑ Yes**
- **☐ No**
- Current number of licences: **3**

### 5. Frequency of interaction
- **☑ Seasonal**
- **☐ Year around**
- **☐ Other**

### 6. Number of tours for focus species
1. **Day**
   - Up to 14 each day
2. **Week**
   - 7 days a week tours operate during the season
3. **Year**
   - Season is normally April to July

### 7. Interaction with focus species
1. Average number of visitors per interaction with focus species: **10 swimmers per swim**
2. Average number of interactions with focus species per tour: **Unsure**
3. Average length of time spent with focus species per interaction: **less than an hour**

### 8. Interactions between operators overlap
- **☑ Yes**
- **☐ No**
- **☐ Unsure**
- Average number of operators: **3**

### 9. Private recreation component interact with focus species
- **Yes**
- **☑ Unknown**
- **☐ No**

### 10. Guidelines, regulations/policies for focus species interaction
- **☑ Yes**
- **☑ Codes of conduct**
- **☐ Memorandum of understanding**
- **☑ Legislation**
- **☐ Policy**
- **☐ Other**

### 11. Knowledge on rate of compliance for tourists
- **☑ Yes**
- **☐ High rates of compliance recorded**
- **☐ Medium rates of compliance recorded**
- **☐ Low rates of compliance recorded**
- **☑ No**
- **☐ Unsure**

### 12. Knowledge on rate of compliance for operators
- **☑ Yes**
- **☐ High rates of compliance recorded**
- **☐ Medium rates of compliance recorded**
- **☐ Low rates of compliance recorded**
- **☑ No**
- **☐ Unsure**

### 13. Tourism interactions with focus species monitored
- **☑ Yes**
- **☐ Unsure**
- **☐ No**

### 14. Knowledge of visitor demographics
- **☑ Yes**
- **☐ No**
- **☐ Unknown**

### 15. Knowledge on visitor satisfaction
- **☑ Yes**
- **☑ Very satisfied**
- **☐ Satisfied**
- **☐ Unsatisfied**
- **☑ No**
- **☐ Unsure**
Examples of Marine Wildlife Tourism in Western Australia

16. Interpretation offered

- Yes
- Tour guide
- Brochure
- Video
- Signs
- Books
- Other ____________________

- No
- Unsure

17. Interpretation

<table>
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<tr>
<th>Yes</th>
<th>No</th>
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</table>

18. Guides trained

- Yes
- Unsure
- No

The operational and social aspects of the framework highlighted quite a number of areas for concern. Areas where there is little knowledge available included total number of interactions, the number of private recreationists interacting with whale sharks, rate of compliance for tourists and operators and type or level of interpretation. After consultation with DEC staff it was decided the current lack of knowledge on the rate of compliance by tourists when engaged in whale shark activities was of most concern. Consequently field research was undertaken on the whale shark tourism industry at Coral Bay to fill this knowledge gap.

Field Testing for Rate of Compliance

This study aimed to test the rate of compliance of tourists swimming with whale sharks at Coral Bay. Whale shark tour charters at Coral Bay are operational from early March until late June or early July, depending on the presence of the sharks. Tours are available for six or seven days of the week depending on the number of people booked for the tour and on the weather forecasts for the region. A minimum of six to eight people is required for tours to commence, with a maximum of 12 for one tour charter and 18 for the other two operators, typically with one boat being used by a single tour charter.

The study took place over 12 days at Coral Bay in June 2007, in which the visitor survey was undertaken. Each day, researchers and volunteer assistants accompanied tourists on the charter boats back from the whale shark interactions, or on occasion, directly from the boat. When researchers accompanied tourists on the tours, general observations began from the first briefing at 8.30am. These observations continued throughout the day as the activities and interactions progressed, with visitor questionnaires conducted at the end of the tour at approximately 3.00pm. Participants for the present study were tourists engaged in the whale shark activities from the Coral Bay location. Tourist numbers typically ranged from between seven to 15 individuals per day per tour charter across the three licensed charter boats, which were run on the basis of minimum numbers and favourable weather conditions. Each survey took an average of five or six minutes to complete in full, and asked participants about their recent whale shark tourism interaction. The surveys included short answer questions regarding information on tourist expectations, actual experiences, knowledge and conservation insights gathered over the tour, and overall satisfaction with the whole interaction.
Results

The study found briefings on the code of conduct concerning the sharks and all wildlife were given to visitors several times during the trip, including an explanation of on-board behaviour, underwater behaviour and the ramifications of any non-compliance. All three charters mentioned that these guidelines were also reinforced with diagrams and visual aids during the briefings. All three charter operators commented that there were no more than ten people in the water at one time with the sharks during the interactions, to reduce the stress on the sharks and to exercise control over people. Swimmers were not to come within three metres of the whale sharks at any time and were to stay at least four metres away from the shark’s tail. In addition, swimmers were not permitted to swim in front of the shark, remaining behind the dorsal fin at all times. Tour boats were restricted to a minimum of 30 metres from the sharks, with other neighbouring tour vessels to stay a further 250 metres away from the interaction zone.

At least one to two crew members were found to be on the boat at all times, observing the on-board behaviour and conduct of clients, while one dive instructor stayed in the water to watch behaviour of people and that of the shark. Compliance to the guidelines and codes of conduct was typically very high, with licensed operators commenting that ‘around 90 per cent of visitors are very polite and well-behaved’. Non-compliance was dealt with on a two-strike system by two of the tour operators. A first time offence would result in a warning, whilst any further non-compliance from the same person would mean a complete swimming ban.

A varied and detailed set of education tools and information provision both during and after the tour activities, including biological, behavioural and anecdotal information, coming in the format of crew talks, brochures, pamphlets, research papers, and viewable diagrams. In addition, details were provided of other sources of information concerning whale sharks and other aspects of the Ningaloo Reef ecosystem should visitors want this additional information. Furthermore, the conservation message concerning whale sharks, and the threats towards them and the local marine ecosystem were reinforced at regular intervals during the tour duration, with specific reference to the type of threats facing the sharks and the reef itself, and what courses of action individuals could take to make a difference.

All this resulted in a very high level of visitor satisfaction that was found with the overall tour experience, with 82 per cent of respondents considering the whale shark tour to be very good to excellent. Furthermore, the study indicated a compliance rate of 100 per cent with regards to no touching of the sharks and an 89 per cent success rate in terms of keeping within the maximum distance of three metres from the animals. Coral Bay’s whale shark tours were observed to have firmly established rules and regulations on issues such as visitor distance from sharks, crew reactions to non-compliance, boat skipper actions to shark behaviour, time spent interacting with the sharks, and number of swimmers interacting with sharks at one time.

Conclusion

By applying the framework to the whale shark tourism industry at Coral Bay WA several gaps in knowledge were highlighted for both the ecological/environmental and the social/operational conditions. After discussions with DEC staff it was decided that research into the rate of compliance by visitors with the current code of conduct in place for swimming with whale sharks was needed. The research, undertaken at Coral Bay, found that rate of compliance by tourists engaged in swim with whale shark activities to be 100%. In addition a high level of satisfaction was found with the overall experience tourism experience. This chapter highlights how the wildlife framework identifies areas of concern and knowledge gaps along with what future research is needed for marine tourism wildlife interactions.
Chapter 5

WHAT THIS STUDY FOUND

The aim of this exploratory study was to develop and test the initial stages of a framework to assess the sustainability of marine wildlife tourism operations in Western Australia. In order to achieve this, a literature review was undertaken examining marine tourism wildlife interactions to develop an understanding of the ecological, environmental, operational and social indicators needed for the framework. Two frameworks were developed—one with ecological and environmental indicators and the other with operational and social indicators.

Key Findings

Scientific knowledge for many marine wildlife tourism operations is lacking

Although much research has been undertaken, there is a need for greater understanding of species’ biology and ecology to minimise impacts from tourism and to determine how to get the best interactions between the wildlife and tourists with minimal impacts (Rodger & Moore, 2004). The development of this framework highlights that there is often little scientific information available for which managers can base their decisions.

Framework indicators need further development and testing

To ensure a robust framework, the ecological, environmental, operational and social indicators all need further development and testing. As this was only an exploratory study, it was not possible to thoroughly test the framework and all the indicators. There is also the need to include economic indicators into the framework.

There is a need for a ‘live’ knowledge database and framework application

Monitoring and sustainably managing marine human wildlife interactions would be more effective and efficient if a ‘live’ database of knowledge was established for each species. DEC needs to establish a database with knowledge on each species including ecological, environmental, operational and social aspects. This database could then be added to as new information becomes available. The framework could then be completed online drawing on up-to-date information from the database.

The framework allows for a comparison across a wide spectrum of marine wildlife tourism interactions

There is substantial congruity of the indicators in the proposed frameworks to all forms of marine wildlife tourism. For example, visitor satisfaction and health and safety requirements and education provision are all of equal importance and relevance to marine wildlife interactions in Western Australia, irrespective of species type (Newsome, Dowling & Moore, 2005). Therefore, while the present example is still being developed, it highlights how feasible a form of assessment could be reliably and validly applied across state-wide marine wildlife tourism operations. For example, the framework could be applied to bottlenose dolphin interactions in Monkey Mia and humpback whales in Fremantle with equal reliability and validity. The success of both marine wildlife tours could then be compared between each other, subsequently highlighting the strengths and weaknesses of either operation. Such comparisons would subsequently provide an opportunity for improved comparisons between charters, increased communication between tourism operators, and the potential for a more thorough, socially and environmentally responsible and successful industry to emerge.
Current Limitations to Framework

Although the framework can highlight areas where research and monitoring are needed it does not prioritise which areas are of most importance.

The framework highlights knowledge gaps and areas where research is needed however in many cases it is not able to indicate which research is of highest priority. It is up to managers, scientists and operators to determine which area of research is of most importance. It is hoped that when the framework is developed into an online application with an up to date database of knowledge then this limitation will be minimised.

The framework does not account for cumulative or long-term impacts of tourism

Unfortunately, research successfully relating the biological significance of the short-term responses to long-term measures is rarely achieved. There are difficulties distinguishing long-term impacts on wildlife from ecological factors. Research therefore needs to be very long term, ten years, in order to be able to detect other demographic responses to wildlife due to tourist disturbance (Bejder & Samuels 2003).

In summary the generic wildlife framework is a simplistic yet effective method of assessing current knowledge on ecological/environmental and operational/social aspects of marine human wildlife interactions. Together these indicators produced a reliable yet simple framework to assess current wildlife tourism interactions. Government managers, tour operators and policy makers can potentially use such a framework to accurately assess and subsequently judge the sustainability of current and future marine wildlife tourism activities. The time and commitment of resources required to generate sufficient scientific information for each species is often lacking therefore this framework is designed to guide the decision making process in relation to where future research and monitoring is needed to ensure the sustainability of current and future marine wildlife tourism operations.
APPENDIX A: WHALE SHARKS—BIOLOGY, ECOLOGY AND TOURISM OVERVIEW

Species Identification
Rhincodontidae Rhincodon typus (Smith 1828)
Listed as vulnerable with a declining population by the International Union for Conservation of Nature and Natural Resources (IUCN (2007).

Biology and behaviour
The whale shark is the world’s largest fish. It is characterised by a broad, flattened head, an enormous, traverse and nearly terminal mouth, large gills slits with internal filter screens, three prominent longitudinal ridges on its upper flanks, a large first and small second dorsal fins, a semi-lunate caudal fin with no sub terminal notch and a unique checker board pattern of light spots and stripes on a dark background (Last & Stevens 1994). Most specimens seen are between four metres and ten metres. The maximum accurately measured sighting is 12 metres long although there are reports of specimens 14 metres in length (Colman 1997). Up until 1999 there were no documented sightings of whale sharks between 93 centimetres and three metres. Characteristic of its large size the whale shark is slow growing, matures late and has extended longevity. These factors limit recruitment and make it susceptible to exploitation (Colman 1997, Pauly 2002).

Whale sharks are extremely mobile and are likely to be highly migratory (Eckert & Stewart 2001, Eckert, Dolar, Kooyman, Perrin & Rahman 2002, Hua-Hsun Hsu, Shoou-Jeng Joung, Yih-Yia Liao, & Kwang-Ming Liu 2007, Graham & Roberts 2007). Their movements are thought to be determined by feeding and physical parameters such as water temperature, currents and wind. Research has also linked their movement patterns to oceanographic features, such as sea mounts and boundary currents, where primary production may be enhanced (Eckert & Stewart 2001, Hua-Hsun Hsu et al. 2007). The whale shark is generally a slow swimmer capable of short, fast, powerful bursts and it has been tracked covering distances of 96 kilometres per day but averaging 25 kilometres per day (Eckert & Stewart 2001, Eckert, Dolar, Kooyman, Perrin & Rahman 2002).

A whale shark tagged in the Seychelles has been resighted in Mozambique, demonstrating a large migration (Rowat & Gore 2007). Whale sharks that have been tagged at Ningaloo have shown varied movement patterns. The whale sharks tagged in 2003 all left the Ningaloo region between May and June and travelled north-east along the continental shelf before travelling offshore into the north-east Indian Ocean. From there two sharks went up towards Ashmore and Scott Reefs. The others terminated closer to Ningaloo, one on the North West shelf and the rest in the open ocean (Wilson, Polovina, Stewart & Meekan, 2006). The movements of these sharks also seem to correlate with the retreat of warm sea surface temperature isotherms towards the equator in late winter (Wilson et al. 2006).

Growth and aging details for the whale shark are sparse (Colman 1997). There have been some estimates from whale sharks in captivity and some from growth rings in vertebrae. Little agreement is seen between the various studies (Stevens 2007). Sightings to date estimate that sexual maturity in male sharks, identified from the calcification of the claspers, may be at about nine metres in length (Beckley, Cliff, Smale & Compagno 1997, Colman 1997). Analysis from photo identification at Ningaloo Reef agrees with this estimate and concluded that 95 per cent of males are sexually mature at nine metres, with eight metres being the minimum length for maturity. At this size the shark is possibly 30 years old (Norman & Stevens 2007).

The whale shark has been confirmed as a lecithotrophic livebearer similar to the nurse sharks. Embryos, approximately 300 pups per litter, develop in brown, horny egg cases and hatch in the uterus (retained oviparity) (Stevens 2007). Where whale sharks go to breed and give birth is unknown. It has also been suggested that female whale sharks travel extensively between breeding and feeding areas and the populations have a high degree of connectivity (Bradshaw, Mollet, & Meekan 2007).
The whale shark is a known filter feeder and has been documented to feed on planktonic and nektonic prey, including small crustaceans such as krill and crab larvae, small schooling fish such as sardines, anchovies, mackerel and occasionally larger prey such as small tuna, albacore and squid (Colman 1997; Last & Stevens 1994; Stevens 2007). It is now thought the whale sharks use the noise of the nektonic species to locate areas of plankton. When observed carefully, it appears that the whale shark keeps a buffer between it and the nekton species and eats only the plankton (Nelson & Eckert 2007, Taylor 2007).

Whale sharks appear to be more active feeders after dusk. Feeding at Ningaloo and along the North West shelf appears to be minimal during the day when only passive feeding has been observed, however, active surface feeding has been observed around dusk (Taylor 2007). According to reports from Nelson and Eckert (2007), whale shark foraging behaviour can be split into three groups:

- active feeding—this is described as ram suction filter feeding and is associated with dense planktonic patches as described above,
- passive feeding—where the shark swims along with mouth agape, slowly gulping. This is associated with very low plankton densities and low effort
- vertical feeding—which is a stationary suction filter feeding in areas of moderate, but localised, prey density. (Nelson & Eckert 2007).

The whale shark is not dependent on forward motion to feed. It has a versatile suction filter-feeding method by which it sucks water into the mouth at higher velocities than dynamic filter feeders like the basking shark whilst remaining vertically or horizontally stationary in the water (Heyman, Graham, Kjerfve & Johannes 2001). This type of surface feeding has been observed when the plankton density is high (Heyman et al. 2001, Clark & Nelson 1997, Nelson & Eckert 2007, Taylor 2007). This allows the shark to capture larger, more nektonic prey, but means it would be less efficient at concentrating diffuse plankton. As a consequence of this, whale sharks may be more dependent on dense aggregations of prey (Colman 1997; Stevens 2007).

Their docile nature and the amount of time spent in shallow, coastal waters makes them susceptible to human predation (Rowat & Gore 2007). The main predator for adult whale sharks is man as they are hunted in some countries such as Taiwan for meat. It has been estimated that Taiwan have been taking approximately 100 whale sharks annually for food whilst other countries, e.g. Philippines, India, Pakistan, Maldives, Indonesia, have a history of harpooning them for the rich liver oil and fins (Colman 1997). However, hunting and trading is now banned in the Maldives, Philippines and India with a ban to take effect in Taiwan from 2008 (Quiros 2007, Florida Museum of Natural History [FMNH] 2007).

Whale sharks are also vulnerable to boat strikes. Mortality from boat strikes has also been recorded, along with several non-fatal injuries from boat strikes (Stevens 2007). Furthermore, there have been reports of the predation of an adult whale shark by two killer whales and bite marks from a large shark have been seen on the dorsal fin of another adult (Stevens 2007).

Whale sharks are typically solitary with no social behaviours being documented in the literature other than congregating to feed. Many sightings of whale sharks are sporadic and unpredictable (Last & Stevens 1994, Beckley et al. 1997, Colman 1997), although predictable aggregations of the sharks are documented across the Ningaloo Reef from the basis of reports from tourist industries. At Gladden Spit, Belize, whale sharks sightings are singular during the day but up to 25 whale sharks may be seen feeding together at dusk (Heyman et al. 2001).
Examples of Marine Wildlife Tourism in Western Australia

Although primarily epipelagic, whale sharks are known to dive regularly to depths close to and greater than 1000 metres tolerating temperatures of 10 °C and colder (Eckert & Stewart 2001, Graham, Roberts & Smart, 2005, Rowat & Gore 2007). Research has shown that free-ranging whale sharks display non random diving behaviour (Graham, Roberts & Smart 2005; Rowat & Gore 2007; Wilson et al. 2006. The reasons behind the diving behaviours are not known but one suggested reason is they are foraging for prey at depth (Wilson et al. 2006, Rowat & Gore 2007). When migrating, it appears that the sharks spend more time at depth with less frequent and shorter periods at the surface (Eckert & Stewart 2001, Rowat & Gore 2007).

Tracking and photo identification of whale sharks has shown that they segregate by size and sex (Eckert & Stewart 2001, Meekan, Bradshaw, Press, McLean, Richards, Quasniclka & Taylor 2006, Graham & Roberts 2007, Norman & Stevens 2007). This may be similar to the sexual segregation that has been documented in other elasmobranchs (Bradshaw 2007). The sex segregation at sites may indicate that an area is unlikely to be important as a breeding site (Norman & Stevens 2007).

Whale sharks are thought to be visually capable of discerning movement at close range, typically within approximately three metres or so. They have been observed to roll their eyes tail-ward and partially retract them during repeated flash photography (Martin 2007b, Norman 1999). Other suggested indicators of stress are diving, porpoising, and banking (Norman 1999).

Whale shark tourism in Australia

In Australia, whale sharks occur mainly off the northern Western Australian Coast at Ningaloo reef, Christmas Island, the Northern Territory and Queensland. Isolated sightings are reported from New South Wales and Victoria (Colman 1997, Davies pers. obs.). Other recorded whale sharks sightings in Western Australia are between Kalbarri and Shark Bay and at the Montebello islands (Colman 1997). The aggregation at Ningaloo is commonly associated with the annual coral spawning event (Taylor 2007). In the Coral Sea a regular aggregation is seen in October and November at the same time as the tuna aggregations and also on Christmas Island in December to April, that is associated with the red crab, Gecarcoidainatalis, spawning (Colman 1997).

Whale shark ‘swim with’ tours started in 1989 as a relatively small industry but by 1993 commercial and public interest had risen considerably (Mau & Wilson 2007). In 1993 the Department of Environment and Conservation (DEC formerly known as Department of Conservation and Land Management or CALM) introduced measures to manage the growing industry in a sustainable manner. This included licences for all the existing commercial vessels and statutory interaction guidelines to minimise negative impacts on the sharks (Mau & Wilson 2007). In 1993 there were 1000 charter passengers, 14 boats and five spotter planes. In 1995 the passenger numbers exceeded 2000 but the number of operators stayed the same (Davis & Banks 1997). In April and May 2005 there were 5000 visitors although tours are run from March to August so the real number is likely to be higher (Catlin & Jones 2006). The industry is now estimated to be worth $12 million to Exmouth annually plus the add-on effect of the additional tourism attracted through the increased knowledge of the area (Catlin & Jones 2006).

At Ningaloo Marine Park the whale shark tourism season runs from March to July with a peak normally occurring in April and May (Mau & Wilson 2007). Although it is often associated with the coral spawning, around March, the reason why whale sharks aggregate here remains unknown (Colman 1997). Approximately 300–500 sharks have been identified from photo identification (Meekan et al. 2006).

Planes spot a shark and direct the mother ship to the shark until the skipper has visual contact. The swimmers are then put into the water 30 metres ahead of the sharks direction of travel, the swimmers may stay in the water until either they tire or the shark dives or swims off. Maximum contact time with the shark is 90 minutes per boat. Other boats may queue up and the next boat can approach the shark after 90 minutes when the first boat must leave (Davis & Banks 1997). This results in a continuous period of interaction for the shark. The industry is managed by the DEC, who manage licensing and conditions of operation (Colman 1997). CSIRO, AIMS, ECOCEAN and the Earth-watch institute all have whale shark research interests in Ningaloo Marine Park.
Photo identification analysis of sharks indicates that the population of whale sharks aggregating at Ningaloo Marine Park is estimated to be around 300–500 individuals (Meekan et al. 2006). Most of the sharks are immature males so it is unlikely to be a breeding area (Norman & Stevens 2007). Little feeding activity is seen by day, some active feeding has been observed at dusk (Taylor 2007). Sex segregation, common in elasmobranches, has been confirmed at Ningaloo Marine Park by two separate studies, Meekan et al. (2006) and Norman and Stevens (2007). This sex segregation, possibly 75–85 per cent male, indicates this area is unlikely to be important as a breeding site (Norman & Stevens 2007). Immature males are dominant and mating or competitive behaviour is not observed (Mau 2006).

Feeding during the day does not appear to be a primary behavioural pattern at Ningaloo Marine Park. The daily movements of the whale sharks adjacent to the reef are not understood (Mau 2006). There is, however, a significant trend for travel along the north-south gradient with a greater northward bound direction favoured. Whale sharks aggregate towards the north at the end of the season (Mau & Wilson 2007).

Two studies have looked at the visitor demographics of the whale shark industry at Ningaloo Marine Park (Davis & Banks 1997, Catlin & Jones 2006). Past visitor surveys show that the mean age of whale shark tourists is 33 years with most tourists aged between 20–30 years old. This profile has remained similar over the years. There is a roughly even gender split with slightly more females (Davis & Banks 1997, Catlin & Jones 2006). In 1995 Japanese and Australians made up 74 per cent of visitors with a significant number of Europeans. By 2005 over half the visitors were Australian, Europeans were still significant but Japanese had dropped to less than seven per cent. The tourists were highly educated with over half the respondents educated at or above degree level (Catlin & Jones 2006).

The overall whale shark experience was rated very highly and comparable in 1995 and 2005 (Davis & Banks 1997, Catlin & Jones 2006). The visitor motivations in 1997 were identified as being close to nature, seeing large animals and other types of marine life, feeling excited and adventurous and to learn about the marine environment (Davis & Banks 1997). As well as closeness to the animal being a consistent best aspect of the trip, scuba and snorkelling activities at different locations in the area, and the service element were more prominent in 2005 (Davis & Banks 1997, Catlin & Jones 2006). In 2005 the negative aspects of the trip were sea sickness and the weather and issues relating to the number of people, i.e. crowding, time with the shark. In 1997 negative responses also involved crowding of people and the shark (Davis & Banks 1997). In 2005 people were more tolerant of other people in the water, with a preferred number of snorkellers of ten as opposed to six recorded in previous surveys (Catlin & Jones 2005).

**Effects on whale sharks as a result of human activity**

Although there is a general lack of knowledge on how whale sharks respond to stressful events several responses have been documented at Ningaloo Marine Park (Mau 2006). The spotter planes at Ningaloo Marine Park have reported that whale sharks actively avoid the whale shark boats (Norman 1999). Sudden diving is thought to be an extreme whale shark response to disturbance when they are surprised or startled (Mau 2006). Whale sharks that have propeller scars have been observed demonstrating stronger avoidance behaviour (Mau 2006).

Individual whale sharks respond differently to boats as diving is not exhibited by all whale sharks. Some whale sharks actively approach boats. Whale sharks can be attracted to the bubbles from idling engines. Others have been observed to dive upon ignition of nearby inboard motors (Mau 2006; Norman 1999). This diving may be a response to the low frequency sound of the motors (Martin 2007b; Norman 1999). Whale sharks spend a lot of time close to the surface resulting in incidences of boat strikes evidenced by a typical scarring pattern on the animals (Norman 1999; Mau 2006; Meekan et al. 2006; Rowat & Gore 2007; Stevens 2007). It is thought this may result in whale sharks showing a higher level of avoidance behaviours including the avoidance of areas which may be critical habitats (Mau 2006; Martin 2007b).
Examples of Marine Wildlife Tourism in Western Australia

When approached by a group of divers or when touched whale sharks have been seen to move faster or dive (Clark & Nelson 1997). In 1997 although instructed not to touch and with a potential $10,000 fine, 34 visitors reportedly touched a whale shark. Regulations in 1997 allowed visitors to be within one metre of the head of the shark and evasive action was therefore difficult if the shark moved towards the swimmer although some respondents admitted to being curious or having the desire to touch the animal (Davis & Banks 1997). In response some sharks have been observed having little reaction whilst others become stressed and respond by changing direction or diving (Quiros, 2007). In some circumstances, is thought that whale sharks will turn their backs upon intruders, banking, as a defensive behaviour to interaction (Martin 2007b; Quiros 2007).

Research on other whale shark tours in Donsol, the Philippines showed that behavioural changes such as banking, abrupt changes in direction or shuddering where more likely to occur when the whale shark was feeding prior to the interaction (Quiros 2007). The research also showed that the probability of a change in direction was more likely the closer the tourists were to the shark. Additionally, tourists free diving towards the shark, flash photography; touching, path obstruction and close proximity were factors which increased the negative response observed in whale shark behaviour (Quiros 2007).

Log books were introduced into charter operations at Ningaloo Marine Park in 1995 and provided information on the size and status of the market, the impacts of the industry and gave the tour operators feedback on tour and passenger information (Mau & Wilson 2007). The average number of swimmers involved in each whale shark interaction has remained fairly constant from 1996 to 2004, with a minimum of 7.5 and a maximum of 11.9 (Mau & Wilson 2007). A summary of the log book information is given in Table 6, which shows that although the popularity of the activity has increased the ‘quality’ of the interaction may be decreasing.

Table 6: Trends in the interaction history of NMP

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<th>1996</th>
<th>2004</th>
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<tr>
<td>Successful interaction on tour</td>
<td>89.5%</td>
<td>79.4%</td>
</tr>
<tr>
<td>No. of interactions/tour</td>
<td>2.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Interaction duration</td>
<td>27 min 24 sec</td>
<td>7 min</td>
</tr>
<tr>
<td>Mean length of whale shark</td>
<td>$6.9 \pm 1.84m$ (1995)</td>
<td>$5.4 \pm 1.45m$</td>
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(Source: Mau & Wilson 2007)

The possible decline of whale shark numbers is a hotly debated point, with log book data showing fewer interactions (Mau & Wilson 2007). The proportion of large whale sharks in the population has also been calculated as in decline between 1992 and 2004 (Meekan et al. 2006). However, it needs to be noted that over the same period of time the total number of spotter plane search hours also decreased significantly as operators shared planes in later years. DEC also question the quality of some of the log book data (Mau & Wilson 2007). Additional factors have been suggested to account for variations in whale shark numbers including: low whale shark aggregations at the northern end of the reef have been observed in years when the Ningaloo current is weak; an increase in whale sharks has been observed during La Nina events; and a decline in coral cover from Drupella damicornis outbreaks has also been linked to low whale shark numbers (Wilson, Taylor, & Pearce 2001; Mau & Wilson 2007).

Individuals have been resighted at the same and different locations within a season and between seasons which may indicate that the migration pathways are not being disturbed by the tourist activity (Mau 2006). Conversely, the interaction times are reducing which may indicate that the whale sharks are becoming less tolerant of the interaction (Norman 1999; Mau & Wilson 2007).
Management issues

DEC has adopted the precautionary principle to guide the development of management of interactive tourism at Ningaloo Marine Park (Mau 2006). In 1993, one-year licenses were introduced for all commercial vessels and interaction licences were granted to all applicants (Davis & Banks 1997). Statutory interaction guidelines were also introduced and have been modified over the years to minimise impacts to the sharks. For example, in 1996 the no swim distance at the head was increased from one metre to three metres to reduce crowding of the shark. As underwater activities are hard for DEC to monitor they rely on the cooperation of the operators for no touching and swim distances (Davis & Banks 1997).

In 1994 DEC included a $7 per person ‘user pays’ charge to subsidise a monitoring vessel (Davis & Banks 1997). DEC continue to monitor the whale shark industry using indicators such as the decline of shark numbers over a long period, health problems, changes in behaviour, increases in aggression or more frequent diving and avoidance behaviour (Davis & Banks 1997). For example, DEC commissioned a review of current and historical research into whale shark ecology and applications for management by Norman in 2002.

In 1995, 13 three-year interaction licenses were issued to allow operators to plan and develop their businesses. In addition two one-year licenses were issued to operators outside Ningaloo Marine Park. The ‘user pays’ charge was increased to $15 per adult and $7.50 per child. The $15 per adult per day did not appear to deter tourists and did not affect demand (Davis & Banks 1997). This charge has subsequently been increased to $20 per adult and $10 per child. The interaction licence period is now five years with a five-year renewal allowing a maximum possible tenure of ten years (Mau 2006).
APPENDIX B: MANTA RAYS—BIOLOGY, ECOLOGY AND TOURISM OVERVIEW

Species Identification
Mobulinae; Myliobatidae, Manta birostris
Listed as near threatened by the IUCN (2007).

Biology and behaviour
The manta ray is the largest of the rays. They are cartilaginous fish with an internal skeleton made of cartilage that is flexible and lightweight. They lack a swim bladder so they sink to the bottom if not swimming while their wing-like pectoral fins extend up to a possible nine metres and they weigh up to 1350—1500 kilograms (Hennerman 2001; Martin 2007a; Passarelli & Piercy 2007). Manta rays are typically about four metres across. At birth mantas rays have a wing span of approximately 1.25 metres and have an estimated life span of 20 years. Mantas differ from stingrays in that they have no stinging spine (Hennerman 2001; Martin 2007; Passarelli & Piercy 2007).

Unlike most species of ray, the mouth on the manta ray is terminal making it ideal for filter feeding. The mouth is broad and rectangular with internal radiator-like gills (Manta Pacific Research Foundation [MPRF] 2007). There is a small band of 300 rows of small, vestigial teeth on the lower jaw which are continually replaced (revolver dentition). These are not attached to the jaws like in bony fish and are not used for feeding purposes, but may play a role in mating and courtship (Hennerman 2001, Martin 2007a). The black and white colour variations on the shoulders and underside, along with scarring patterns, are thought to be unique and can be used to identify individuals (Hennerman 2001; Martin 2007a; Marshall 2007; Passarelli & Piercy 2007). There are also regional variations, with some mantas in the eastern Pacific having an almost dusky grey to black underside but displaying a mostly snow white on their underside in the western Pacific (Martin 2007a).

Manta migration patterns are unknown however as the species is a plankton feeder it is likely that the species migrates (Martin 2007a). The manta ray is a filter feeder, consuming plankton and small to medium sized schooling fish (Hennerman 2001). When feeding, the two cephalic fins are unrolled and held at a downward angle to create a funnel guiding prey into the enormous terminal mouth as the ray swims forward (Hennerman 2001). These fins have also been observed to ‘scoop’ food into the mouth (Martin 2007a). The food is filtered out by spongy tissue between successive gill bars (Martin 2007a; Passarelli & Piercy 2007). The excess water exits through five pairs of gill slits on the ventral surface. This feeding mode is called ram-jet feeding (MPRF 2007). Feeding often occurs at the surface where the plankton collects (Hennerman 2001). Manta rays have been observed repeatedly somersaulting slowly along as they feed in plankton rich areas (Martin 2007a; Passarelli & Piercy 2007). The species may consume over two percent of their body weight per day predominantly at night when the planktonic food rises to the surface (MPRF 2007; Martin 2007a).

Male manta rays are thought to mature at sizes of approximately four metres and females at five metres (Passarelli & Piercy 2007; Martin 2007a). The male rays typically start the mating process by chasing the female attempting to grasp the females’ pectoral fin. The male manta ray has two claspers located at the inner margin of the pelvic fins as is typical of elasmobranches. Once he has the female’s pectoral fin in his mouth, the male positions himself abdomen to abdomen with the female. The male inserts the claspers into the cloaca for about 60–90 seconds (Yano, Fumihiko & Takahashi 1999). Manta rays are ovoviviparous, with a single ‘pup’, which is wrapped in a thin shell that breaks inside the female, and subsequently the live young is born (Martin 2007a). The gestation period is estimated at nine–12 months or more but it is not known when and where the species gives birth, however it is thought to be in shallow water where the young would remain for some years (Martin 2007a; Passarelli & Piercy 2007).
Manta rays are not thought to be social animals, only showing social behaviour through courtship and mating. Although they frequently aggregate at feeding and cleaning stations, they show no signs of social interaction (Martin 2007a); although during human-based interactions they are often described as inquisitive (Last & Stevens 1994). They are fast swimmers and are known to ‘jump’ out of the water. Juveniles leap completely out of the water and adults drive themselves partway out of the water and then flop back (Last & Stevens 1994; Martin 2007a). The reasons for the rays’ ‘jumping’ behaviours are unknown but it is speculated that the rays are attempting to rid themselves of parasites, escaping predators or as some part of a courtship ritual (Hennerman 2001; Martin 2007a).

Manta rays are pelagic and circum-global, they are found in the warm temperate and tropical waters of all oceans (Last & Stevens 1994; Hennerman 2001; Martin 2007a). They are mostly observed on the surface but are known to go to depths of 30 metres however as this is the observation limit for recreational divers so a maximum depth is unknown (Hennerman 2001; Martin 2007a). They have also been observed visiting cleaning stations where cleaner wrasse remove small crustacean parasites from the skin and gill cavities (Hennerman 2001). Some mantas have been reported to visit the stations every day, sometimes for up to 6 hours (Marshall 2007; Passarelli & Piercy 2007).

Manta rays at Coral Bay

At Ningaloo Marine Park, it is believed that the aggregation of manta rays is related to the coral spawning around March (Hennerman 2001; Martin 2007a), however manta rays are present all year round in varying numbers (McGregor pers. comm. 2007). Both sexes are present and both colour variations are present. Manta rays with the black underside, often called black manta rays, as well as those with the predominantly white underside. It is not yet known how long each manta stays in Coral Bay; some are more regularly sighted than others. Some manta rays have been repeatedly seen in the area over a period of years. Regular sightings of mature and pregnant females are common but regular sightings of juveniles have not been confirmed. When many mantas aggregate in Coral Bay, mating behaviour has been observed although it is believed that the aggregations are formed predominantly because of feeding opportunities (McGregor pers. comm. 2007).

There are currently no interaction licences issued specifically for manta rays at Coral Bay but this is due to change in the near future (Mau pers. comm. 2007). Currently tourism operators may interact with the manta rays on an opportunistic basis, as may recreational boaters do. Concern has been raised by DEC (Mawson per comm. 2007) about swim-with manta operations at Coral Bay as the manta rays have previously shown signs of aggression towards humans with some actions resulting in injury to swimmers.

Effects on manta rays as a result of human activity

The only known predators of adult manta rays are large sharks and humans (Hennerman 2001). Humans target them for the use of their meat, skin and oil-rich liver resulting in resident populations having recently been decimated off the Pacific Coast in Mexico and in the Philippines, most likely as a result of this activity (Hennerman 2001).

The reaction of manta rays to tourism has been varied. They have been observed to approach divers and appear to enjoy interaction. Conversely, other reports of manta ray-human interaction have shown that the species can also become wary of divers and cease to approach them (Martin 2007a). Dive guides have reported that the tolerance level of the mantas varied from individual to individual. Some mantas allow one touch before leaving; others allowed a longer interaction (MPRF 2007). In areas where divers often touch mantas, they have been seen to develop pink skin lesions, lasting for months, where the mucous coating is removed (MPRF 2007, Martin 2007a).

An unknown number of manta rays aggregate at Coral Bay WA in an enclosed, small, sandy bay north of the settlement. Currently more people are swimming with manta rays at Coral Bay than whale sharks due to their presence all year round (McGregor pers. comm. 2007). However tourist activities may cause mantas to change their behaviour during the interaction due to tourist numbers making it difficult for mantas to leave the enclosed bay. Interactions with mantas swimming along the reef in open water are considered less of an issue as the manta ray has room to manoeuvre and can avoid interaction and excessive disturbance (McGregor pers. comm. 2007).

Management issues

A photo identification library in Coral Bay has begun to establish how many manta rays use Coral Bay, how long they stay and ascertain what the manta rays are doing there. There is also a tagging program underway to
work out movements of manta rays in the area (McGregor pers. comm. 2007). A code of conduct has also been
developed and will be introduced as part of the new licensing conditions for manta ‘swim with’ activities (Mau
pers. comm. 2007). The code will be based on similar principles to the whale shark code of conduct but it will
address actual distances and behaviours applicable to manta rays. For example, it will recommend that critical
habitat areas be avoided, as will interactions with manta rays displaying courting/mating behaviour (Mau pers.
comm. 2007). The code of conduct will not apply to recreational boats at this stage.

A potential problem identified at Coral Bay is from the huge pressure on the tour operators to guarantee a
‘swim-with’ opportunity for the tourists (McGregor pers. comm. 2007). This pressure can be transferred onto the
particular animals that show site fidelity or are unable to leave the enclosed, sandy area where they aggregate.
This pressure could lead to issues of non compliance with the proposed code of conduct, similar to those noted in
Ningaloo Marine Park where there have been reports of non compliance increasing at times of low whale shark
numbers and high tourist numbers (Mau 2006).
Species Identification

Super-family—Dasyatidae
Species—*Dasyatis brevicaudata*—larger species (Short-tail stingray)—native to Western Australian waters.
Other observed, closely related species—*Dasyatis thetidis*—smaller species (long-tail stingray)
Both species listed as least concern by IUCN Red List in 2008.

Biology and behaviour

The species of Australian, short-tailed and long-tailed stingrays are part of an extensive group of cartilage-based vertebrates known as Chondrichthys, which include over 300 species of sharks, rays, skates and chimaera (rat-fish) (Daley, Stevens, Last & Yearsley 2002). Within this class is the order Rajiformes, which classifies all ray species, within which the family group Dasyatidae is found, which groups together all whip-tail stingray species. The short-tailed stingray (*Dasyatis brevicaudata*) is one of the 69 species of whip-tailed stingrays within this group (Compagno 2005).

Whip-tailed stingrays have a relatively uniform body-pattern, consisting of a flat-bodied cartilage-based fish, with no caudal fin (Daley et al. 2002). This is accompanied by five pairs of gill openings on the underside of the body, a body width no greater than one and a half times the total body length, and a long whip-like tail past the main body of the animal, typically with thorns, barbs or round projections located along the tail (Daley et al. 2002). The species *Dasyatis brevicaudata* is the largest of all the worlds’ stingray species, reliably reaching four metres in length with wing-spans in excess of two metres (Cavanagh, Kyne, Fowler, Musick & Bennett 2003). At this size, individuals have been known to exceed 300 kilograms in weight, though large females are typically more likely to reach this size than males (Cavanagh et al. 2003).

Reproduction within the species is viviparous, with the female giving birth to live young, which average 35 centimetres when initially born. However, critical aspects of reproduction in the species, such as breeding season, age and size at sexual maturity, litter size and gestation period are still largely unknown (Cavanagh et al. 2003). The diet of the species consists mainly of small-to-medium fish species, with scavenging noted as part of the stingrays’ food intake (Cavanagh et al. 2003). Behaviour patterns, such as mating and migratory movements are also not properly understood, although large aggregations noted in both Australia and New Zealand have thought to be associated with mass-breeding (Cavanagh, et al. 2003). However, the species does appear to favour shallow water, with individuals in both Australia and New Zealand rarely recorded below a depth of 100 metres (Daley et al. 2002; Cavanagh et al. 2003).

Short-tailed stingrays are located across much of the world’s temperate southern seas, particularly along the coasts of Australia, New Zealand and South Africa (Cavanagh et al. 2003). Within Australia the species is found in a large band across the southern half of the country, as far north as Shark Bay in Western Australia and the southern tip of Queensland on the east coast. Favourite ecosystems for this species are considerably varied, with consistent sightings in shallow coastal bays, rocky shore reefs, open sea floors and occasionally on the surface of outer reef shelves (Daley et al. 2002).
Stingray tourism in Australia

In Australia, interactions with stingrays are mostly opportunistic ‘swim-with’ experiences either through recreational diving and snorkelling, or via commercially booked marine tours for other species such as dolphins (Newsome, Lewis & Moncreiff, 2004). However, the most recent extension of stingray tourism has occurred in the small south-west township of Hamelin Bay in Western Australia (Lewis & Newsome 2003). The rays are found typically from December to March, over the hotter summer months and draw large numbers of tourists to the south-west region. The interactions consist of opportunistic feeding and interaction sessions with groups of up to 20 patrons of varying ages. The interactions usually occur around the middle of the day, involving groups of around 16 short-tailed stingrays, and occasional visits by long-tailed stingrays (Dasyatis thetidis) and southern eagle-rays (Myliobatis australis), with fish scraps being provided by local fisherman (Lewis & Newsome, 2003). Members of the public are able to wade in the shallows next to the feeding stingrays and take photographs or occasionally touch the rays (Newsome, Lewis & Moncreiff, 2004). This wildlife interaction has still not yet been formally developed, but has already drawn considerable interest and popularity from resident from both international and local tourist groups alike (Lewis & Newsome 2003).

Effects on stingrays as a result of human activity

In Australia, and throughout the Southern hemisphere, stingrays are typically at most risk from both commercial and recreational fishing as well as recreational aquatic activities. Stingrays are often taken as a by-catch in a variety of trawling and long-line fishing activities, both in recreational activities and commercial fishing industries. When caught in this manner stingrays will often have their tails amputated before being released as a safety measure for other people in the area, while injuries or death from being tangled in the lines or nets is relatively common (Cavanagh et al. 2003). Other impacts on stingrays have included excessive motor boat presence in rocky bays, harbours and reef areas, which have either caused direct injury to the rays or heavily degraded resting and feeding areas (Newsome, Lewis & Moncreiff, 2004).

Within the wildlife tourism industry, tourism interactions have improved the public understanding and perception of stingrays and the importance they have within the local reef and bay ecosystems (Lewis & Newsome 2003). However, additional potential impacts to stingrays as a result of marine tourism, appear to be less beneficial (Department of Environment [DOE] 2001). A number of potentially negative impacts derived from public behaviour towards the stingrays has the capacity to be highly detrimental to stingray behaviour and their physical health (Newsome, Lewis & Moncreiff, 2004). Feeding activities in marine wildlife tourism in general, while certainly popular, have often been accompanied by numerous potentially damaging consequences (Orams, 2002). A recent investigation by Newsome, Lewis & Moncreiff, (2004) identified up to 37 risky behaviours by tourists, including large numbers of children touching or falling close to the rays, touching the tails of the stingrays, and forceful movements that restricted the rays; movements including crowding or blocking escape attempts by individual rays. This intrusive and potentially excessive activity may well cause long-term stress and abnormal behaviour, as well as lesions and other physical health problems for the rays that frequent the area.

Furthermore, it may increase the chances of injury to the rays from motor boats that move in and out of the harbours in the bay. Rays have also been observed to be excessively aggressive towards fisherman and snorkellers in the area, seemingly expecting to be given food items in the area where interactions take place (Newsome, Lewis & Moncreiff, 2004). This subsequently is felt to increase the chances of a reduction in natural feeding patterns and instincts in the rays, therefore reducing their chances of survival in the wild.

Management issues

The goal for emerging stingray tourism ventures, particularly that of Hamelin Bay in Western Australia, is to properly establish a series of guidelines and management practice codes to ensure the long-term safety and welfare of both the stingrays and the visiting public. Lewis and Newsome (2003) commented that an improvement in the information services and protocols, both about the Hamelin Bay area and the stingrays in general, is likely to reduce negative public behaviour towards the rays. Protection and zoning management, such as a ‘no-take’ stance within the feeding and observation areas, may also improve the behaviour and sense of responsibility held by local fisherman and the Hamelin Bay community to this newly developed tourism operation (Newsome, Lewis & Moncreiff, 2004). At present, there is no designated area for stingray interactions within Hamelin Bay, which needs to be formally established to reduce close contact with rays, visitors and boating activities across the region (Newsome, Lewis & Moncreiff, 2004). Group numbers, time limits with wildlife and proximity to the rays are not formally set, which again is likely to need proper development and regulation. Finally, a more formal set of management guidelines and code of conduct with both wildlife and
A FRAMEWORK TO GUIDE THE SUSTAINABILITY OF WILDLIFE TOURISM OPERATIONS

visitors with the Hamelin Bay operations needs to be properly devised and understood within the Hamelin Bay community and assessed, monitored and regularly reviewed if negative impacts on the stingray species are to be kept to a minimum (Newsome, Lewis & Moncreiff, 2004).
APPENDIX D: BOTTLENOSE DOLPHINS—BIOLOGY, ECOLOGY AND TOURISM OVERVIEW

Species Identification

*Delphinidae Tursiops truncates* (Common bottlenose dolphin)
*Delphinidae Tursiops aduncus* (Indo-Pacific bottlenose dolphin)

This is the current description of bottlenose dolphins with the Indo-Pacific dolphin being described as a separate species (Simmonds 2004).

Biology and behaviour

Dolphins can be recognised by their typically torpedo, or spindle, shaped bodies with prominent flippers and flukes. The bottlenose dolphin is a medium to large size dolphin with a distinctive beak. They are slate grey or charcoal in colour with a paler ventral surface while their large, flat tail is used to propel the dolphin forwards by moving up and down (Simmonds 2004).

Dolphin biology is mainly typical of all mammals, with a chest cavity holding the lungs and heart which is separated by the diaphragm from the abdominal cavity. Bottlenose dolphins must breathe air, but can stay underwater for eight to ten minutes although the average time is around two to three minutes. They are protected from cold water by a thick blubber layer that acts as insulation and a vitally important energy store (Simmonds 2004).

Dolphins are known to use echolocation for communication within the group to coordinate activities and for hunting prey. Human understanding of their communication techniques and their meanings is still severely limited; however the use of audition is known to be the dominant sense (Simmonds 2004). Dolphins have a specialised ear which means that they can localise sound underwater and determine the source and frequency of the sound emitted to an exceptional degree. Most sound reception may occur though the fatty tissue in the lower jaw (DDC 2005). Dolphins eyesight is typically strong enough to allow them see clearly in water and air. In addition, they are also thought they have a reasonable ability to detect various smells underwater (DDC 2005).

Bottlenose dolphins feed mostly on fish and cephalopods but their diet can vary depending on location. Echolocation is used to hunt prey enabling dolphins to detect small prey targets hundreds of metres away (Simmonds 2004). They may also make use of stealth and herding techniques, with the whole group working cooperatively and varying the technique, depending on the local conditions and the prey type. Dolphins have also been observed striking fish with their tails to incapacitate them (Simmonds 2004). Most bottlenose dolphins will dive regularly to depths between three–45 metres, which is mostly thought to be associated with hunting for prey (DDC 2005).

Studies have shown that cetacean distribution is often linked to habitat. In the Moray Firth, NE Scotland, for example, the density of bottlenose dolphin populations in the area has been observed to be related to feeding behaviour aggregations (Hastie, Wilson, Wilson, Parsons & Thompson 2004). The distinctive patterns of distribution shown by bottlenose dolphins in many locations may be related to foraging behaviour or opportunities. Submarine habitat characteristics, for example, may be a significant factor in the foraging efficiency of dolphins (Hastie et al. 2004). Such high densities of dolphins in foraging areas have also been documented off the south coast of Zanzibar (Stensland, Carlen & Bignert, 2006).

The main predators of bottlenose dolphins are other larger bottlenose dolphins, orcas (killer whales), large sharks and humans (DDC 2005). There is evidence that dolphins will group together to collectively repel shark attacks (Simmonds 2004). Dolphins are at threat from humans as a by-catch in net fisheries, direct hunting and in response to the increased presence of human activities in the ocean. These include coastal developments, increases in boat traffic, offshore explorations and tourism activities (Marsh et al. 2003a). In addition noise pollution is thought to be a significant threat to the dolphins, as the oceans get noisier through increasing numbers of ships and boats, seismic and exploration activities. Too much noise may damage the tissues and ears of cetaceans as well as result in changed behaviour or the abandonment of important locations. Some noises may lower the effectiveness of, or ‘mask’, their communications (Simmonds 2004).

Dolphins in Bunbury WA are found to be sexually active all year but tend to breed in the summer months when the female dolphin will mate with many males (DDC 2005). Females are sexually mature in their early
teens and males a little later while their lifespan is estimated at 40 years for males and 50 years for females (Simmonds 2004). The gestation period for a female bottlenose dolphin is typically 12 months. The female gives birth to live young, tail first. Care begins immediately with the mother, or ‘aunt’ pushing the calf up to the surface to take its first breath. The female will wait until she has weaned this calf, usually after two to three years, before calving again, therefore following an inter-gestational pattern of one calf every three to four years (Simmonds 2004; DDC 2005). This mother-calf association is thought to be important, as the calf learns from its mother how to hunt and about social structure within dolphin pods (Simmonds 2004). Calves weigh about 30 kilograms at birth and will be 0.5–one metre in length. A fully grown dolphin can weigh between 110 and 400 kilograms and between one and a half to four metres in length. Coastal populations tend to be smaller in size whilst the larger dolphins are predominantly oceanic (Simmonds 2004, DDC 2005).

Bottlenose dolphins are highly social animals living in groups that can vary in size from a few individuals to several thousand animals for the offshore populations. Dolphins are known to coordinate their actions within the group. This is a social advantage and important for protection against predators, finding food and rearing young. The relationship between mother and calf is very strong and the calf will typically swim just under and behind its mother (Simmonds 2004). Other close relationships within dolphin groups have also been observed. For example, male bottlenose dolphins have been observed to form allegiances to protect certain mature females from other males. Also the composition of the groups within populations may change rapidly and is dependent on location, overlapping home ranges, demography and group activity (Bearzi 1997, Simmonds 2004).

Bottlenose dolphins are very active and can be observed playing with pieces of seaweed or other animals (DDC 2005). They touch each other regularly with their flippers, flukes and rostrum, nuzzle against each other and swim close together. This behaviour can last for over an hour. The meaning of the behaviour is unclear as courting or touching behaviour does not always lead to mating (Simmonds 2004; DDC 2005). Dolphins sleep, resting one side of the brain, lying with their blowhole exposed above the surface of the water moving in slow, simple patterns. In this state, dolphins can rest for short periods but still remain aware of their environment (Simmonds 2004; DDC 2005). In recent years researchers have begun to define various aspects of dolphin behaviour (see Table 7).

Table 7: Summary of the behaviour traits of bottlenose dolphins

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>social</td>
<td>leaping, chasing and engaging in body contact, play and mating behaviours, genital inspections, individuals move around in groups, varying dive intervals, low group cohesion</td>
</tr>
<tr>
<td>foraging/diving</td>
<td>chasing fish on surface, coordinated deep diving for long intervals with loud exhalations, peduncle and tail visible on dive entry, rapid circle swimming but not chasing other dolphins, no individual contact. Presence of prey around or in mouths of dolphins. Direction of movement and group cohesion varies</td>
</tr>
<tr>
<td>rest</td>
<td>slow movements as a tight group, sometimes stationary, constant direction, regular and long, synchronous dive intervals</td>
</tr>
<tr>
<td>slow travel</td>
<td>persistent directional movement at speed &lt; three knots</td>
</tr>
<tr>
<td>slow travel +</td>
<td>as slow travel but also foraging, socialising</td>
</tr>
<tr>
<td>travel</td>
<td>persistent directional movement at speed &gt; three knots</td>
</tr>
<tr>
<td>fast travel</td>
<td>dolphins porpoising in a persistent directional movement</td>
</tr>
<tr>
<td>milling</td>
<td>no net movement, frequent directional changes, transition behaviour, variable but short dive intervals, varying group cohesions may be associated with other behaviours</td>
</tr>
</tbody>
</table>

(Constantine, Brunton & Dennis, 2004; Lusseau 2004; Stensland, Carlen & Bignert, 2006)

Bottlenose dolphins are found throughout the worlds oceans, in coastal or oceanic areas. They range as far north as Scotland, UK and as far south as Milford and Doubtful Sounds, New Zealand. Despite the global distribution of the species, they are frequently found in isolated populations that range along discrete areas of coastline (Constantine, Brunton & Dennis 2004). While bottlenose dolphins are commonly found throughout Australia, the main populations observed are along both east and west coastlines, including the Great Australian Bight in South Australia and coastal communities of Tasmania. In specific reference to Western Australia, the species has been observed all over the state’s coastline, as far south as shallow bays in Esperance and as far north
Examples of Marine Wildlife Tourism in Western Australia

as Exmouth at Ningaloo Reef.

Most dolphin populations are thought to be at least semi-resident to the area where they are normally seen, with dolphins appearing to show site fidelity and although their home ranges may be large they have favourite spots for socialising, foraging and resting (Lusseau & Higham 2004, Stensland, Carlen & Bignert 2006, Hastie et al. 2004). The home range of dolphins seems to also depend on geographic location. For example, dolphins resident in Doubtful Sound rarely leave the fjord for more than a few hours whilst the dolphins in the Northern Adriatic have a home range greater than 800 kilometres² (Bearzi, Notarbartolo-di-Sciara, & Politi 1997, Lusseau & Higham 2004).

In Australia, there are around 90 licenses for boat-based dolphin watching operations. While in Western Australia there are two ‘swim-with’ operations in Rockingham and Bunbury.

- Rockingham—approximately 120–150 bottlenose dolphins, at an average age of 15 years old. The ‘swim with’ interactions typically involve around 30 swimmers per day, with one tour operator in charge of proceedings, apparently trying to habituate certain dolphins
- Bunbury—approximately 100 bottlenose dolphins, one operator, 18 tourists per trip and up to two trips a day.

Effects on dolphins as a result of human activity

Several species of dolphin, whale and porpoise have been reported to have shown behavioural changes associated with boating activities (Marsh et al. 2003a). A summary of the main responses recorded are:

- swimming away from boat, avoiding interaction
- tighter group cohesion
- changes in behaviours, surfacing patterns, feeding, resting, socialising, during the interaction
- delays in returning to the pre interaction behaviour
- stronger behavioural changes as the number of boats in the vicinity increased
- increased whistling rate on boat approach.

(Janik & Thompson 1996; Constantine, Brunton, & Dennis 2004; Lusseau 2004; Bejder, Samuels, Whitehead, Gales, Mann, Conner, Heithaus, Watson-Capps, Flaherty & Kruetzen, 2006b)

A long-term study looked at a population of Indo-Pacific bottlenose dolphin at Shark Bay in Western Australia over a series of years. When the number of tourist boats increased from one to two a decrease in the abundance of dolphins in the area was recorded. Although this decline may not jeopardise a large, genetically diverse population, a similar decline would be devastating for small, closed, resident, or endangered cetacean populations (Bejder et al. 2006b).

Dolphins avoiding an area can have greater impact if the site was a preferred location for an important activity. For example, fewer bottlenose dolphins in Clearwater, Florida, were found to forage in primary sites when boat traffic increased, potentially reducing energy intake for this population (Allen & Read 2000). While bottlenose dolphins in Bay of Islands, New Zealand, are reported to stop resting and engage in milling behaviour in the presence of boats, suggesting that this population is disturbed. A reduction in resting time may result in a decrease of energy reserves, which could affect foraging efficiency, vigilance levels, and the level of parental care (Constantine, Brunton & Dennis 2004). Research on bottlenose dolphin populations in Milford and Doubtful Sounds in New Zealand also recorded reduced resting and socialising behaviours in the presence of boats, negatively effecting energy budgets. Many dolphins also avoided Milford Sound in the times of high intensity boat traffic (Lusseau 2004).

Bottlenose dolphins were observed to surface less when the dolphin watch vessel approached but not with other vessels and human-related traffic (Janik & Thompson, 1996). The dolphin watch vessel typically stayed closer to the dolphins for longer than boats passing through the channel. A decrease in surfacing indicates the dolphins were either diving for longer periods or removing themselves from the area. The dolphins appeared to be able to distinguish the approach of the dolphin watch vessel from other boats (Janik & Thompson 1996).

Dolphins in Sarasota Bay, Florida, decreased the distance between animals, changed heading and increased swimming speed on approach of a vessel (Nowacek, Wells & Solow 2001). The distance between animals and the changes of heading responses were more likely when the dolphins were in shallow water. Shallow water has been identified as an area of potential importance for mothers and calves (Nowacek, Wells & Solow 2001). It is also an area where the possibility of boat strike seems to increase. A study looking at seasonal boat strikes in
A FRAMEWORK TO GUIDE THE SUSTAINABILITY OF WILDLIFE TOURISM OPERATIONS

Sarasota Bay, Florida found more strikes occurred in shallow coastal waters than in the deeper offshore waters. The increased noise at busy boating times may increase the probability of boat strikes. The dolphins that were injured were frequently neonates, inexperienced mothers and a dolphin with a pre-existing deformity (Wells & Scott 1997).

Increased group cohesion in cetaceans has been suggested as a means for group members to better track each other’s movements and accelerate responses to danger. Increased cohesion has been documented in the presence of vessels (Nowacek, Wells & Solow 2001, Bejder et al. 2006b). This reaction may indicate that even if dolphins don’t exhibit avoidance behaviour, the encounter may still be stressful (Bejder, Dawson & Harraway 1999, Nowacek, Wells & Solow 2001, Buckstaff 2004, Ribeiro, Vida & Frites, 2005). In the case of Shark Bay dolphins smaller sub groups were formed potentially splitting up mutually reliant associates, thereby escalating predator risk (Bejder et al. 2006b). While studies on the dolphins in Sarasota Bay, Florida showed that the dolphins reacted to oncoming boats with an increase in whistle rate and by swimming in tighter groups. These dolphins are highly conditioned to boat noise, with some individuals being passed by a boat every six minutes, yet they still display responses to boat traffic (Buckstaff 2004).

Dolphins at Hilton Head Island, South Carolina, displayed changes in behaviour and direction of travel, when numerous boats were present (Mattson, Thomas & St. Aubin 2005). Chilean dolphins in Yaldad bay, Southern Chile, were studied to determine their response to boats. One recorded response was greater group cohesion (Ribeiro, Vida & Frites 2005). Foraging dolphins reacted by changing direction more frequently and travelling dolphins increased their swimming rate. Dolphins did return to their previous behaviour after the interaction but this took longer for dolphins that had been foraging (Ribeiro, Vida & Frites 2005). For bottlenose dolphins, feeding has been recorded as the least likely behaviour to be interrupted by tour vessels and socialising the most likely to be interrupted (Samuels, Bejder, Constantine, & Heinrich 2003).

There are fewer studies that specifically investigated the reactions of dolphins to swimmers as to those investigating boat interactions, but this remains a particularly prevalent issue for Western Australian dolphin interactions such as the Monkey Mia and Bunbury tour operations. Other parts of the world have already observed how this may be the case. A long term study, repeated across two research periods, 1994–1995 and 1997–1998, was carried out on wild, non-provisioned common bottlenose dolphins in Bay of Islands, New Zealand (Constantine 2001). The results showed that juveniles were more likely to interact with boats and swimmers than adult dolphins, that the interaction success of tourist boats decreased over the years and that avoidance behaviours increased. The dolphins interacting with boats were often small subsets of a larger group (Constantine 2001).

The Department of Environment and Conservation (DEC) has issued an interaction licence for ‘swim with’ activities at The Dolphin Discovery Centre (DDC). In 1999 the tour licensee developed a voluntary code of conduct for ‘swim with’ interactions. The guidelines of this code were more specific than the DEC licence conditions (O’Neil, Barnard & Lee 2004):

- maximum of one tour per day
- ten swimmers per tour
- one and a half to two hour duration (Max 60 minutes in water)
- compulsory tourist education briefing
- snorkel refresher course
- five minimal impact procedures
  - best approach guidelines
  - assessment of dolphin behaviour
  - limit to the number of swimmer attempts
  - no touching, use of snorkel lines.

The Dolphin Discovery Centre is working in conjunction with Murdoch University to try to understand more about dolphin ecology and about the factors pertaining to human disturbance. Understanding the possible impacts from ‘swim with’ activities issues can lead to better management and a more sustainable of dolphin tourism (DDC 2007). Research topics are:

- to identify the population dynamics of the bottlenose dolphins in the bay and how this changes over time
- to identify the importance of different habitats used by bottlenose dolphins in the bay
- to quantify the effect of boat traffic (including tourism activities) on bottlenose dolphins in an area of
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high human impact, and compare results to more pristine areas.

Management issues

An area of concern for management is the possible impacts on the dolphins from ‘swim with’ activities. A potential problem identified is the pressure on the tour operators to guarantee a swim-with opportunity to the tourists. Similar to manta rays this pressure can be transferred onto the particular animals that show site fidelity.
APPENDIX E: HUMPBACK WHALES—BIOLOGY, ECOLOGY AND TOURISM OVERVIEW

Species Identification
Family—Balaenopteridae
Species—Megaptera novaengliae (Borowski, 1781)
Listed as least concern by the IUCN (2008).

Biology and behaviour

The humpback whale (Megaptera novaengliae) is a member of the sub-order Mysticeti, within the cetacean order of whales, dolphins and porpoises (Clutton-Brock, 2002). This sub-order makes up all 12 species of baleen-plated whales, which are distinguished from the other 71 species of cetaceans by the long-haired plates along the mouth designed to catch small invertebrate prey (Clutton-Brock, 2002). The humpback whale is part of the family group Balaenopteridae containing eight species, and the only member of its genus Megaptera (Clutton-Brock 2002). The whale is relatively easily physically identified by its broad rounded head, low hooked fin, unique knob-like tubercules under the chin and a black top body with a conspicuous white underbelly. Other major physical features include exceptionally long pectoral fins, often up to five metres, and a distinct ‘plume-like’ blow spout (Menkhorst & Knight 2001). This is one of the largest species of cetacean, and subsequently one of the largest animals of any kind to be found on the planet. Fully grown adults average approximately 14 metres in length and weigh in between 30 and 35 tonnes, with some large males known to reach 18 metres and exceed 40 tonnes (Menkhorst & Knight 2001).

The humpback whale, like all other baleen species, is a filter feeder, focussing primarily on shrimp-like species of krill and other small macroplankton as it’s food source (Baker 1990). The species will use its’ large pectoral fins to scoop large concentrations of water and marine invertebrates into its mouth (Clutton-Brock 2002). From this point, the large baleen plates will scoop up the invertebrates as the water passes through the whales’ body, and the tongue will wipe the tiny prey from the baleen plates and pass it along to the stomach (Baker 1990). This species has been shown to adopt specific hunting strategies in order to catch large concentrations of prey (Clutton-Brock 2002). One of the more frequently observed and documented strategies is ‘bubble-netting’, whereby the whales will blow large bubbles of water from low depths, driving the prey into tightly packed swarms close to the surface for easy collection (Baker 1990; Clutton-Brock 2002). Using this strategy, the whale can consume several tonnes of krill and macroplankton species in a single day (Baker 1990).

Reproduction with the species typically occurs at known feeding grounds or wherever large congregations of the species occur (Clutton-Brock, 2002). Males will engage in unique breeding and courting songs, each with their own distinct type of song in order to communicate with females and other males in the region (Smith, Goldizen, Dunlop & Noad, 2008b). This form of courtship and communication is unique among most mammals, with females selecting males with the loudest and longest song, and with the strongest physical strength (Smith et al. 2008b). Females will give birth to a single calf, after a gestation period of 11 months (Clutton-Brock 2002). The young calf will suckle and stay with the female for two years, remaining close to her side for the initial migration back to seasonal feeding grounds (Szabo & Duffus 2008). This extent of mother-calf connection and association is very strong and essential to the chances of the calf avoiding predation from large marine predators, and growing strong enough and gaining sufficient knowledge of food collection techniques and migratory pathways (Smith et al. 2008b). The importance of this mother-calf relationship is reinforced by recent research findings indicating that the survival rate of first-year calves is relatively low when this parent-offspring bond is broken, while adult survival rates are considerably higher (Gabrielle, Straley, Mizroch, Baker, Savy, Herman, Glockner-Ferrari, Ferrari, Cherchio, Von Ziegesan, Darling, McSweeney, Quinn, & Jacobson, 2001; Mizroch, Herman, Straley, Glockner-Ferrari, Jurasz, Darling, Cherchio, Gabriele, Salden, & Von Ziegesan, 2004).

Humpback whales are typically solitary throughout adult life, maintaining a heavy foraging and migratory habit. Individuals will usually meet up only in areas of high food concentration, or for breeding purposes (Menkhorst & Knight 2001). Small groups of individuals, often mothers with calves, are occasionally observed congregating during migration, or across long channels close to the shore (Menkhorst & Knight 2001; Pamilla & Rosenbaum 2006). Recent investigations by Pamilla and Rosenbaum (2006), however, have suggested that most congregations of this nature do not involve genetically-related individuals, aside from mothers with calves.
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Though mostly solitary, social interaction has been readily observed when such congregations are observed, including a number of vocal and behavioural displays and body postures such as full-body breaching, tail-slapping and spy-hopping (Kaufman & Forestell 1986). This level of behavioural variation is rarely seen in the majority of the other cetacean species, making the humpback whale one of the more frequently photographed and identifiable species of whale in the world (Dalton & Issacs 2000).

Humpback whales are located across all of the world’s oceans at different times of the year as they migrate to and from various seasonal feeding and breeding grounds (Menkhorst & Knight 2001). In addition, they are found along either coastlines or deep seas, often diving to great depths for long periods, or keeping close to the surface around coasts and bays (Clutton-Brock, 2002). Distribution and location in the southern hemisphere has been more readily documented than those individuals in northern seas, though it is felt that the same individuals travel across both hemispheres through migratory patterns (Menkhorst & Knight 2001). The temperate, warm waters surrounding Australia and New Zealand have been favourite areas for humpback whale feeding and resting during seasonal migration to southern Antarctic waters (Menkhorst & Knight, 2001; Smith et al. 2008b). Consistent observations of the species are recorded along the East coast of Australia, including Southern Queensland, New South Wales, Victoria and Tasmania (Menkhorst & Knight 2001; Stockin & Burgess 2005; Stamation, Croft, Shaughnessy & Waples 2007). Within Western Australia, *M. novaeangliae* is seasonally common across many coastal locations, with the most notable areas for observation around Exmouth and Coral Bay to the north and south to Perth and Albany in the south-west (Menkhorst & Knight 2001).

Whale-watching has become arguably the biggest form of wildlife tourism across the globe, resulting in an industry that has become an annually multi-million dollar enterprise (Dalton & Issacs 2000). These tours have now been established across many of the world’s major nations, with licensed tours and charters located through North America, Chile, South-east Asia, Europe, Africa, and numerous island chains in the Bahamas, Hawaii, and the Galapagos (Spalding 1998; Heckel 2001; Neves-Graca 2004). Within Australia, whale-watching tours are located across every state, with the main species of interest in the majority of cases being the humpback whale (Kaufman Lagerquist, Forestell & Osmond, 1993). Humpbacks are most commonly observed in tour-based situations and in interactions across Hervey Bay and Bundaberg in Queensland and Byron Bay and Sydney Harbour in New South Wales, and at a series of locations across the Western Australian coastline (Dalton & Issacs 2000).

Western Australia has become one of the primary locations in the world for watching humpback whales through structured wildlife tourism charters (Kaufman et al. 1993). Across the state, there are 110 individual tour licenses for whale watching activities, located primarily at seven major towns; Exmouth, Shark Bay, Perth, Fremantle, Albany, Cape Leeuwin in Augusta, and Cape Naturaliste in Yallingup (Dalton & Issacs 2000). All tour charters program their seasons to coincide with the annual southern migration of the whales to feeding and breeding grounds in the Antarctic, with operators in Exmouth and Shark Bay offering interactions between May and September, while operators in towns further South running tours later on as the whales travel south, typically between September and December (Dalton & Issacs 2000).

Humpback whales are the focus of the tours and the most commonly observed, although southern right whales are also occasionally seen on the trips (Mills Charters 2008). Multiple tours from each location are held several days a week during these seasons, typically in mid-mornings and lasting anywhere from two to four hours (Dalton & Issacs 2000). With an average of over 100 visitors per trip, these tours allow members of the public to observe and photograph the whales’ activities in their natural habitat, while being provided with light refreshments and information and conservation details of the species by crew members and boat skippers (Mills Charters 2008; Dalton & Issacs 2000). In addition, a small handful of these charters are equipped with underwater microphones, to allow visitors to hear vocal communications between whales that are spotted (Mills Charters 2008). Many of these tour operations will also provide extra sources of information and research to visitors and conduct private research as a means of assisting local and global conservation efforts on humpback whales and other threatened marine species (Wiley, Moller, Pace & Carlson 2008).

Effects on humpback whales as a result of human activity

The threat of human beings’ activity on the health and population diversity of whale species has been an issue of significant debate and speculation for many years, dating back to commercialised whaling in the 18th century (Wiley et al. 2008). Commercial whaling across the world, during the 19th and 20th century in particular, caused a significant reduction in the majority of whale species, with many baleen whales hunted to the brink of extinction (Baker 1990). Since 1985, global bans on commercial whaling have resulted in recoveries in numbers of many previously highly threatened species. The humpback whale is one of the more notable examples, which has seen
a consistent rise in numbers throughout the world's oceans, with notable increases in migration numbers around the Western Australian coastline (Kaufman 1993). Despite this, Japan, Norway and Finland have boycotted such bans and continue to hunt a handful of whale species under the guise of scientific research (Higham & Lusseau 2007). Recent attempts to include humpback whales in these scientific hunts have so far been unsuccessful, although it is not fully known if they are completely avoided in modern-day whaling.

The wildlife tourism industry is now the most common form of contact between whales and human beings (Wiley et al. 2008). The potential of whale watching as an effective conservation tool and sustainable financial benefit is gradually becoming a global phenomenon, and has the capacity to improve chances for species survival through international community support and increases in research funding (Wiley et al. 2008). This statement appears particularly applicable to the humpback whale tours within Western Australia, which have developed into a highly popular and successful industry due to the species' highly flamboyant nature and high level of intelligence and inquisitiveness (Dalton & Issacs 2000).

Current projections indicate that the demand for whale watching will continue to increase beyond five per cent per year for several years to come (Hoyt 2001). It has been identified that this increase in demand is happening at a faster rate than management controls can be put in place to protect cetaceans (Samuels et al. 2003). As a result, concerns have been raised about the extent of exposure of the whales to large boats with large numbers of people on an almost daily scale (Beach & Weinrich 1989; Higham & Lusseau 2007). The increased frequency and size of tourism vessels may have the potential to cause significant alterations to humpback whale behaviour and physical state. Cetaceans use sound to navigate, find food and interact with other co-specifics. Noise pollution from boats and other tourism activities can potentially damage hearing and mask signals. Masking makes prey detection harder and can isolate animals from the group (Lusseau 2008). Furthermore, there is the risk of operator vessels being forced by public demand to encroach too close to the whales, such as mothers with calves, and therefore cause excessive stress or discomfort or interrupt feeding sessions or social interaction (Beach & Weinrich 1989; Higham & Lusseau 2007). This concern has been raised by other investigations on whale tours along the east-coast of Australia and in other known whale watching charters around the world, such as the Azores and Chile (Beach & Weinrich 1989; Spalding 1998; Neves-Graca 2004). Other risks associated with this practice are potential cuts and injuries to the whales from propellers and being bumped by boats being in close proximity (Beach & Weinrich 1989).
Management issues

Given the variety of risks associated with whale-human contact, the need for official regulations, codes of conduct and monitoring systems in humpback whale watching is critical if it is to be a successful and ecologically responsible operation (Wiley et al. 2008). Whale watching practices throughout Western Australia have devised codes of conduct and guidelines for monitoring and regulating human interaction with the whales, while providing as much information on the species and gaining visitor feedback after the sessions (Mills Charters 2008). The following set of regulations devised by the Department of Environment and Conservation (DEC) apply to all charters and whale watching practices within Western Australia. Typically, the information is presented to visitors during briefs and on-board discussions to ensure visitor understanding and awareness of such regulations:

- Only persons with vessels licensed by DEC are to operate commercial vessel tours involving whale watching.
- Persons on private vessels (including surfboards, kayaks, yachts, launch-boats etc.) do not require whale watching licenses but must still adhere to the same regulations as those on commercial whale watching operations.
- Aircraft such as spotter planes are not to fly within 300 metres of a whale, except by special authorisation.
- Swimming with, touching or feeding of whales is completely prohibited. If individuals find themselves swimming with a whale by accident, they must endeavour to remain a minimum of 30 metres from it.
- Any vessel or vehicle that is within 300 metres of a whale is within the ‘contact zone’ of the animal, and can only be allowed to continue interaction if official licenses are granted.

Figure 1: Approach and contact zone limits for interaction with whales in Western Australia (DEC 2008)
A series of rules and regulations have also been put in place for interacting with whales within the ‘contact zone’:

- Vessels must not cause whales to alter their course of direction or speed of travel.
- Vessels must not separate or significantly disperse pods of whales in the area.
- Vessels must not approach whales from a direction within an arc of 60 degrees, whether in front or behind the animal (Figure 1).
- Vessels must not approach to within 100 metres of a whale, except under specially licensed ‘research’ vessels that are consistently monitored.
- In instances where whales move towards vessels and breach the 100 metre limit, the vessel master must move into neutral or reverse and slowly move back into a safe distance from the whale, at a speed not exceeding five knots.
- Vessels must not block or hinder any escape paths or attempts by whales to move away from the area.
- Vessel masters must abandon interactions with the whale if it becomes noticeably distressed or alarmed or if a significant physical condition is evident.

(DEC 2008).

In addition to adhering to such rules, whale watching tours have been strongly encouraged to produce high quality information regarding the species involved, their respective ecosystem relationships and the need for their conservation (Higham & Lusseau 2007). In Western Australia, the majority of licensed tour charters have introduced formal and informal talks and interactive video documentaries on board vessels during the tours (DEC 2008; Mills Charters 2008). Brochures and contact details to other sources of information are also typically provided on such tours to allow visitors further access to more detailed information. Furthermore, feedback information is also sought by many of the Perth-based charters, to gain an insight into the success and potential for improvement in the whale watching experience (Mills Charters 2008).
Examples of Marine Wildlife Tourism in Western Australia

APPENDIX F: SEA LIONS—BIOLOGY, ECOLOGY AND TOURISM OVERVIEW

Species identification

*Neophoca cinerea* (Peron, 1816)
Listed as lower risk, least concern by the IUCN (2007). Listed as vulnerable by the TSSC (2005).

Biology and behaviour

Thirty-five species of pinniped have been identified with five of these being sea lions; the rarest being the Australian sea lion (*Neophoca cinerea*) which is endemic to Australia (McKenzie, Goldsworthy, Shaughnessy & McIntosh 2005; Orsini 2004). Relatively little is known of its behaviour and biology (Campbell, 2005). Unique among other pinnipeds, the Australian sea lion has a non-annual breeding cycle which is asynchronous across the breeding colonies (Threatened Species Scientific Committee [TSSC] 2005). Due to this unusual breeding cycle, they are sensitive to disturbances in their environment (Orsini 2004).

The foraging method used by this species is an activity that is at the limit of its physical diving capacity and as such is energy intensive (Williams 2001; Orsini & Newsome 2005; Orsini, Shaughnessy & Newsome, 2006). The method utilised by these species is that of a benthic feeder (on or near the bottom of the ocean) which consequently restricts the foraging depths of the sea lion to approximately 100 metres and prevents feeding from occurring in the open ocean (Orsini, 2004). The main prey species taken by *N. cinerea* and other sea lions species are benthic fish, cephalopods, crustaceans, sharks and seabirds (Goldsworthy Bulman, Larcome & Littnan, 2003; Lowry & Forney 2005). Sea lions are in their turn, also preyed upon. Species that have been noted to use sea lions as prey species in Australia are the white shark, the bronze whaler shark, the seven gill shark and killer whales (McKenzie et al. 2005).

Marked sexual dimorphism is present in *N. cinerea*, with males being longer, heavier and darker in colour than females (TSSC 2005). Sexual dimorphism is also present in other species of sea lion with females being smaller than males and differing in colouring (Gales and Fletcher 1999). *N. cinerea*’s gestation period lasts up to 14 months and it has a protracted breeding period of four to seven months from the birth of the first pup to the birth of the last pup of the season. Australian sea lions also have a long lactation period of 17.5 months with the females also demonstrating extreme levels of natal site fidelity as they only breed at the site they were individually born at (TSSC 2005).

The Australian sea lions’ current range extends from the Houtman Abrolhos Islands in Western Australia to the Pages in South Australia (Campbell 2005). Before the exploitation of these mammals occurred however, this range extended to Bass Strait. Due to the impact of hunting by humans and their subsequent commercial exploitation in the 1700s and 1800s, the range of this mammal has contracted from its pre-European settlement extent (Campbell 2005). With three main regions there are now 73 individual breeding colonies (McKenzie et al. 2005).

Tourism activities

Australian sea lions are the focus of tourism activities which comprise viewing of, and visitation to the breeding colonies and haul-out sites (Newsome & Rodger 2008). ‘Swim-with’ tours as well as guided onshore tours are conducted with this species. These tours are conducted in Baird Bay, Seal Bay and Kangaroo Island in South Australia and on Carnac Island in Western Australia (Newsome & Rodger 2008). In a study conducted in Baird Bay, South Australia, no significant effect upon the sea lions has been observed from interactions with tourists (Martinez 2003). The actual effects observed were an increase in the vigilance of the sea lions when on land. The tourism activities conducted here are boat viewing tours and commercial swims (Martinez 2003).
Sea lions are not essentially the focus of the tourism activity which may impact on them. Another species may be the focus and the sea lions are simply unfortunate enough to be sharing the site in question (Newsome & Rodger 2008). Management practices need to be put into place so that this unintended interaction may be controlled and monitored. Tourists who arrive at a sea lion haul out site independently of any tourism management may have an impact upon the animals. Actions by humans resulted in sea lions being disturbed to such an extent that they swim away on Seal Island in Western Australia. Attempts have also been made to hand feed the sea lions (Newsome & Rodger, 2008). Human intrusion and unsupervised interaction with sea lions can result in the disturbance of sea lion behaviour and also can interfere with natural behaviour. Response to human behaviour can depend upon the sex and age of the individual (Newsome & Rodger, 2008).

**Effects on sea lions as the result of human activity**

The commercial hunting of sea lions in the 1700 and 1800’s in Australia affected the sea lions to such an extent that they have not recovered their numbers to a sufficient extent to be able to recolonise haul out sites which were the focus of the hunting activities (TSSC 2005). This is due in part to their breeding cycle being over such an extended period of time, as well as the pupping season being protracted to four to five months. Pup mortality in their first five months being up to 45 per cent also contributes to the slow replacement of this species (TSSC, 2005).

Commercial fishing has also affected the sea lion population. Entanglement with debris resulting from fishing activities can result in sea lions drowning. Approximately 1.3 per cent of the population dies in this manner each year (TSSC, 2005). Fatalities are also caused by individuals foraging in cray-fish and lobster pots, becoming trapped and subsequently drowning. Measures have been taken to attempt to prevent this from occurring, with exclusion devices being fitted to cray-fish and lobster pots (TSSC, 2005).

Other human caused injuries and deaths have been noted. These include injuries inflicted upon animals from boat propellers and animals being speared or shot (Orsini, 2004). In a review conducted between 1980 and 1996, shooting was the first cause of death that was recorded in a review of sick, injured and dead pinnipeds in Western Australia (Mawson & Coughran 1999; Orsini 2004).

**Management issues**

Management practices need to be put into place to regulate human interaction with sealions. For example, approach distances need to be established and in some cases, interactions may need to be restricted. The disturbance of sea lions by tourists in an attempt to excite a reaction also needs to be eliminated (Orsini 2004; Orsini & Newsome, 2005). The Department of Environment and Conservation (DEC) is responsible for the management of four out of the five haul-out sites in the Perth region (Orsini 2004) and action has been taken to limit the effects of tourism by regulation and monitoring, the use of licenses for tourism operators and by the prohibition of human trespassing on key haul-out areas (Orsini 2004).

Such actions are necessary to reduce the possibility of alteration of behaviour as a result of external stimuli that could negatively affect population replacement by disturbing breeding activities, by influencing mother and pup interactions and by influencing the time spent at haul-out sites and thus energy expended (Orsini & Newsome 2005; Orsini, Shaughnessy & Newsome 2006; Newsome & Rodger 2008).
Species Identification

*Dugong dugon* (Müller, 1776)
Listed as vulnerable by the IUCN (2007).

Biology and behaviour

The only herbivorous mammal that is strictly marine-based, the dugong is the only extant species of the Dugongidae (Marsh, Penrose & Eros 2003b). Growing to over three metres and weighing up to 450 kilograms, these animals have a low reproductive rate, long generation time and a high investment per offspring and may live for 70 years or more (Reeves, Stewart. & Leatherwood 1992; Marsh, Penrose & Eros 2003b). A female’s first calf is generally not born until the mother is at least ten or up to 17 years old. The gestation period for these mammals is 13 to 15 months and the calf then suckles for 14 to 18 months although the calves also begin eating seagrasses soon after birth. The periods between reproductive attempts vary with estimates ranging from 2.4 to seven years (Marsh, Penrose & Eros 2003b).

The diet of the dugong consists of seagrasses which they uproot whole when accessible. When this is not the case, the leaves of the plant are eaten. The sea grass species which are preferred by the dugong are those which are lowest in fibre and highest in available nitrogen and are easiest to digest (Marsh et al. 2003). As visibility may be poor in the dugong’s foraging areas, they communicate using underwater vocalisations and rely upon their hearing to sense their surroundings (Anderson and Barclay 1995; Gerrard 1999).

Dugongs can be found in coastal waters of 37 countries (Marsh, Penrose & Eros 2003; Ilangakoon and Tun 2007). This range stretches through east Africa, through south and south-east Asia to Australia (Marsh, 2002). The major concentrations of dugongs occur in wide, shallow protected bays, in the lee of large islands and in wide, shallow mangrove channels (Heinsohn, Marsh & Anderson 1979). These animals have also been observed regularly further offshore in deeper water where the continental shelf is shallow, wide and protected (Marsh, Penrose & Eros 2003b).

Tourism activities

Dugong watching cruises are operating in parts of Western Australia (Marsh, Penrose & Eros 2003b) and especially at Shark Bay WA listed as a World Heritage Area in 1991 (Gerrard 1999). In the study conducted by Gerrard (1999), a significant relationship was discovered between the effect upon dugongs and the speed of the approach vessel. As the speed of the vessel approaching increased, so did the level of disturbance of the dugongs. The key speeds were below two knots and above two knots and it was concluded that tour boat watching of dugongs was having a negative impact upon the short-term behaviour of the dugong with disruptions to their foraging and travelling behaviour (Gerrard 1999).

Effects on dugongs as a result of human activity

Relatively little is known of the ecology of dugongs and the effect human impacts have upon them when compared with other marine mammals. Visibility may be poor in the areas in which these mammals forage, increasing the chance of collisions between motor powered water craft and dugong (Gerrard 1999). Habitat loss is also affecting these animals as the seagrass ecosystems which they graze are very sensitive to human impacts. Activities such as mining, trawling, boating, dredging, coastal and island clearing and land reclamation can or do affect seagrass ecosystems, thus in turn affecting dugong habitat. When seagrass ecosystems are lost, dugongs respond by either moving a long distance away or by consequently putting themselves at extreme risk of death by starvation (Marsh, Penrose & Eros 2003b). Dugong deaths are also caused by entanglement in fishing equipment. Additionally dugongs have also become entangled in shark nets that were set to protect swimmers in Australia. The replacement of these nets with baited hooks has decreased the mortality rate (Marsh, Penrose & Eros 2003b).
Management issues

Little knowledge is currently available on possible impacts of tourism on dugongs. Therefore, how to ensure that tourism activities have no long term effect upon dugongs while utilising tourism as a method for increasing awareness of the animals is a difficult task, but one that must be tackled in order to assist this species survival. Legislation, marine protected areas and regional co-operation are all methods that need to be adopted to increase the protection afforded to dugongs (Marsh, Penrose & Eros 2003b).
APPENDIX H: TURTLES—BIOLOGY ECOLOGY AND TOURISM OVERVIEW

Species Identification

Green turtle: Chelonia mydas—listed an endangered by the IUCN Red List 2004
Loggerhead turtle: Caretta caretta—listed as endangered by the IUCN Red List 1996
Hawksbill turtle: Eretmochelys imbricate—listed as critically endangered by the IUCN Red List 2008
Flatback turtle: Natator depressus—currently data deficient for listing by the IUCN
Olive ridley turtle: Lepidochelys olivacea—listed as vulnerable on the IUCN Red List 2008
Leatherback turtle: Dermochelys coriacea—listed as critically endangered on the IUCN Red List 2000

Biology and behaviour

Sea turtles have been described as living fossils from the time of dinosaurs (Wilson & Tisdell 2001). They have a large shell called a carapace, four strong paddle-like flippers. Similar to all reptiles they have lungs for breathing air, and therefore need to surface regularly. However, they are able to adjust their metabolism in order to spend longer periods of time under water. They are known to leave the ocean when females need to lay their eggs on beaches and on occasions bask in the sun during the nesting season (DEC 2010).

Six of the turtle species that are found on the northern beaches of Australia, including the green, loggerhead, hawksbill, flatback, olive ridley and leatherback turtles, generally nest during the summer months in the evenings (October - March) (Limpus, 2009). With long life spans turtles are also slow to reach sexual maturity. Studies have shown that it can take between ten and 50 years for a turtle to begin to breed. They have also been reported to migrate long distances between their feeding grounds and nesting sites with both males and females returning to the region where they were born to mate and nest. Females nest every two to eight years and lay between one and ten clutches of thirty to one hundred and eighty eggs. The sex of the turtle hatchlings is determined by the nest temperature in the beginning stages of embryo development. Cooler temperatures mainly result in males hatchlings while warmer temperatures produce females hatchlings (DEC 2010).

Tourism activities

In Australia interactions with turtles can be boat based or shore based encounters, or through snorkelling and diving experiences. There are 60 recorded operators in Australia that offer some form of turtle tourism (Birtles et al. 2005. In 2005, there were 15 dedicated shore-based turtle tour operations in Australia (Birtles, Curnock, Dobbs, Smyth, Arnold, Marsh, Arnolds, Valentine, Limpus, Hyams, Dunstan, Charles, Gatley, Mangott, Miller, Hodgson, Emerick & Kendrick 2005). The tour operations attract large numbers of visitors (Tisdell & Wilson, 2001). Tours focussing on viewing nesting adults and hatchlings on beaches in their natural environment take place in Queensland on Heron Island, Mon Repos, Lady Elliot Island, in Western Australia on Dirk Hartog Island, Exmouth, Coral Bay, Lacepede Island and Dampier Peninsula and in the Northern Territory on Bathurst Island and Bare Sand Island (Birtles et al. 2005).
Effects on turtles as a result of human activity

Marine turtle species in Australia are experiencing serious threats to their survival. Threats include pollution, changes to turtle habitat, accidental drowning in fishing nets, over harvesting of turtles and eggs, along with tourism. Tourism can have serious impacts on turtles that come ashore at night to nest as they can be disturbed by artificial lights, off-road vehicles and fires on beaches (Ehrenfeld & Koch 1967; Jacobson & Lopez 1994; Johnson, Bjorndal & Bolten 1996). The presence of artificial lights and people can lead to turtles returning to the ocean without nesting and/or turtles abandoning a nesting attempt if approached closely. Continual presence of tourists may also result in a shift in nesting locality (Jacobson & Lopez 1994), potentially to a less viable beach in terms of successful reproduction, and increase energetic costs as a result of increased nesting attempts (Lutz & Musick, 1997).

Management issues

Management practices need to be put into place to ensure the regulation of human interaction with turtles with particular attention given to nesting turtles. If tourism focussed on nesting turtles is to be expanded, then strict guidelines are needed. Guidelines need to be developed in consultation with marine biologists, indigenous owners, government agencies, non-government organisations along with other stakeholders (Waayers 2009). These guidelines will potentially help ensure the limitation of negative impacts and disturbance to nesting turtles which will reduce the possibility of population replacement by the disturbance to breeding activities.
Examples of Marine Wildlife Tourism in Western Australia

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Examples of Marine Wildlife Tourism in Western Australia

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- Travel and tourism industry
- Academic researchers
- Government policy makers

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Sustainable Tourism Cooperative Research Centre (STCRC) is established under the Australian Government’s Cooperative Research Centres Program.

STCRC is the world’s leading scientific institution delivering research to support the sustainability of travel and tourism—one of the world’s largest and fastest growing industries.

Introduction
STCRC has grown to be the largest dedicated tourism research organisation in the world, with $187 million invested in tourism research programs, commercialisation and education since 1997.

STCRC was established in July 2003 under the Commonwealth Government’s CRC program and is an extension of the previous Tourism CRC, which operated from 1997 to 2003.

Role and responsibilities
The Commonwealth CRC program aims to turn research outcomes into successful new products, services and technologies. This enables Australian industries to be more efficient, productive and competitive.

The program emphasises collaboration between businesses and researchers to maximise the benefits of research through utilisation, commercialisation and technology transfer.

An education component focuses on producing graduates with skills relevant to industry needs.

STCRC’s objectives are to enhance:

- the contribution of long-term scientific and technological research and innovation to Australia’s sustainable economic and social development;
- the transfer of research outputs into outcomes of economic, environmental or social benefit to Australia;
- the value of graduate researchers to Australia;
- collaboration among researchers, between searchers and industry or other users; and
- efficiency in the use of intellectual and other research outcomes.